School outreach from universities:

A case study of the UnIChe school outreach program

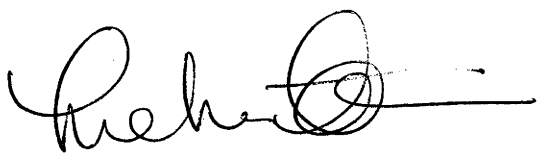
Leharne Fountain

November 2006

A thesis submitted in partial fulfilment of the requirement for the degree of Master of Science of the Australian National University

Statement

The submitted thesis *"School outreach from universities: A case study of the UnIChe school outreach program"* is my own work and all sources used in the thesis have been acknowledged.

Signed: 

Date: 16/05/06

Abstract

As tertiary science enrolments continue to decline, universities are adopting a variety of strategies to encourage students to continue science studies into university. One approach taken is to engage with schools through outreach programs.

During 2002, the Research School of Chemistry at the Australian National University (ANU) ran a school outreach program called UnIChe. The program aimed to attract senior chemistry students in the ACT and surrounding NSW, to study chemistry at the ANU. While the program was well-accepted by those schools which participated in the program, the overall rate of participation was less than we had hoped—out of fifty schools invited to take part, only thirteen accepted.

This sub-thesis identifies the factors which contributed to the low rate of participation by schools in the UnIChe program. These can be divided into characteristics of the program itself, and factors within the school environment. This research indicates that teachers are more likely to choose to engage in outreach that relates to the curriculum; places minimal onus on them to organise; and is delivered in a style that is engaging for their students. Other factors include the teachers' preconceptions about outreach formed through past experiences of outreach, including their perceptions of the impacts of outreach and their perceptions of universities. Issues within individual schools and across the school system also form barriers to participation, such as time-tabling constraints and curriculum pressures.

More generally, this thesis identifies features that will assist universities in designing effective and mutually beneficial programs of university-school interaction and improve communication between universities and schools. These are expressed as a series of recommendations to universities contemplating science-based school outreach.

Acknowledgements

It has been a long and complex journey. It has taken a while to travel, but I've made it.

I would firstly like to thank the teachers and university staff that participated in this research. Without their insights and opinions, this case study would not have been possible.

I am grateful to Dr Phillip Reynolds for employing me to coordinate the UnIChe school outreach program in the first place, and for agreeing to allow me to conduct this research project. I hope my work will be useful to your future outreach efforts.

Special thanks to my friends and (former) fellow-masters students, Sheila Lunter and Merryn West, whose encouragement and advice along the way inspired me to keep going whenever I forlornly lost sight of the end (which was often). Thanks also to my friend Craig Smith who provided comments on the draft manuscript.

I thank my friend and work colleague Felicity Edge for assisting me to take a month of study leave to get things moving at the beginning of this research, and for patiently listening to me each day for the past few years, lament about my lack of thesis-free weekends.

I am especially grateful to my supervisor Dr Sue Stocklmayer, who provided insightful comments and advice throughout the course of this research, and whose support, particularly in the latter stages, kept me on target.

Finally to my husband Andrew, who put up with my constant agonising throughout this research, and who contentedly resigned himself to the fact that he was to be a "thesis widower" for what seemed an indefinite number of years, I can't thank you enough. I promise to spend more time with you this year and not to embark upon another thesis for at least a few more...

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Chapter 1: Introduction

Introduction

In response to declining university enrolments in science, the Australian Council of Deans of Science in 1999 commissioned a study to investigate patterns of science participation in universities over the last decade. The report, entitled *Trends in Science Education*, revealed a marked decline in the number of students undertaking science studies in secondary school, a poor rate of transition from secondary to tertiary study in science, and little movement in many of the foundational or 'enabling' sciences [Dobson & Calderon, 1999].

In an Occasional Paper published to highlight issues from the original report, the Australian Council of Deans of Science suggested that the tertiary sector ought to play a role in encouraging secondary science students to continue studying science at university [Australian Council of Deans of Science, 1999: 17].

This recommendation is also made in a report prepared in 2000 for the Department of Education, Training and Youth Affairs (DETYA). The report claims that universities, as well as other scientific organisations, need to interact with school students and their teachers to make science more tangible and relevant [Goodrum, Hackling, & Rennie, 2000: 170].

Interactions between universities and schools are not new. There is a long history of university-school relations in Australia; this has, however, been principally in the area of teacher training. There is a large number of studies on the benefits, challenges and pitfalls of these relationships [e.g. Grundy, Robinson, & Tomozas, 2001; Peters, 2002; Smedley, 2001]. The relatively recent advent of relations between universities and school students, such as school outreach programs and open days, has opened up a new avenue in the relationship. Within these programs, a distinction can be made between those with purely recruitment-driven motives, and those with more altruistic educational goals. There is little research on just what effects these differing motives have on the efficacy of outreach programs; empirical research on school outreach programs in Australia in general is scant. Questions regarding why universities run

such programs, what impact they are having in addressing the current trends in science education, the features of effective programs, or the difficulties involved, remain largely unanswered in the literature. What literature exists provides mainly "cook-book" instructions on how such programs have been run with only passing mention of these larger issues.

If universities are to play a role in addressing the issues facing science education in Australia through school outreach and similar programs, several questions remain. These include questions about what aims and attributes these programs should have, what form they should take, who should be involved in running them, and how to evaluate or measure their impact.

Purpose statement

The research aims of this study are multilayered. The specific aim is to explore the factors that influenced a group of teachers in their decision whether to participate in a school outreach program from the Research School of Chemistry (RSC) at the Australian National University (ANU) in 2002.

Beneath this lies a more general aim—to stimulate universities already involved in, or contemplating running school outreach programs, to consider what their own reasons for running outreach are, and to provide them with an understanding of how outreach is viewed and received by schools. It is hoped the study will identify features that will assist universities in designing effective and mutually beneficial programs of university-school interaction and improve communication between universities and schools.

Another aim is to provide a basis for further research in this emerging area on which little research exists. While it aims to answer questions, it inevitably leads to more questions and highlights areas that warrant further exploration.

Background to the study

In October 2000, five university chemistry and chemical engineering groups from the Universities of Melbourne and Newcastle, and the ANU, came together with Orica, Australia's largest chemical company, to form a collaborative alliance. The resulting project is called UnIChe, which stands for 'University-Industry links in Chemistry'.

The UnIChe project was awarded funding from DETYA under the Science Lectureships Initiative in October 2000 for a three year period. The project aimed to:

- attract the best students to study chemistry, and to train them in such a way that provides awareness of the needs and goals of the Australian chemical industry;

- produce graduates with an understanding of the financial and interpersonal skills required for successful industrial management; and

- develop stronger links between the Australian chemical industry and universities [Australian National University, n. d.-c].

While initial phases of the project focussed on the link between universities and industry through undergraduate and graduate programs, the need to address the link between universities and schools and to target school-leavers soon became apparent [Bailie, 2001].

In November of 2001, a school outreach program was piloted as part of the UnIChe project at the ANU. The general aim of the school outreach program was to raise awareness of career options in science, and specifically chemistry, among upper secondary chemistry students. Its primary goal however, was recruitment-driven: to attract the best chemistry students to study chemistry at university—at the ANU in particular.

The program was presented to senior chemistry students as a one hour seminar and discussion period. The presentation was made in two parts, the first to address the relevance of chemistry and career options in chemistry. This twenty minute talk contained three main themes: chemistry in every day life; career options in chemistry; and studying chemistry at the ANU. Issues related to going to university in general were also discussed. A particular effort was made to include careers not seen to be typical chemistry careers, such as archaeology, art restoration and science journalism. This component was presented by the program coordinator. The second presentation was designed to give students an idea of the kind of chemistry research that takes place at universities, and was presented by a research staff member from the RSC.

No systematic feedback was collected from the program, although the coordinator reported receiving positive comments from teachers and students [Bailie, 2001].

Based on these comments, the school outreach program was recommenced in February 2002 at which time I was employed to coordinate the program on a part-time basis. In this role I liaised with teachers and university staff to arrange visits to schools, and presented the careers component of the program at the schools.

During the school visits I was able to directly observe the reaction of students and teachers to the program. I also had the opportunity to listen to chemistry, science and careers teachers talk about the daily challenges in their classrooms—especially in relation to completing a seemingly ever-growing syllabus in shorter and shorter available time.

Through these interactions I became interested in what motivates universities to run outreach programs, why schools participate in them, and what difficulties exist in making this relationship mutually beneficial.

Statement of the problem

We received positive comments about the UnIChe school outreach program, as well as formal feedback from the schools we visited, and many teachers expressed interest in participating in future programs. Despite this, the participation rate in the program was less than we had hoped—out of fifty schools invited to take part only thirteen accepted.

If programs such as this are to be part of the solution in addressing declining science enrolments, understanding the reasons for this low response rate could provide valuable information to universities planning outreach. Is the low response indicative of a poorly designed program, or simply poor communication between the university and the schools? Are there other factors in the school environment that limit their participation in such programs? If the decision-making processes of teachers considering involvement in school outreach programs were better understood, universities could implement more effective and mutually beneficial programs. Clarifying the aims and quantifying the impact of these programs is also a key concern

as universities are investing increasingly vast amounts of time, resources and effort into running such programs.

This study therefore aims to explore the factors which contributed to the low participation rate of schools in this program. More generally, it aims to identify features that could assist universities in designing effective and mutually beneficial programs of university-school interaction and improve communication between universities and schools.

Research questions

This research problem led to the formulation of a theoretical proposition:

Outreach programs need to have certain characteristics to be "successful"— that is, to satisfy the needs of both partners: the university and the schools

In the case of the UnIChe outreach program, the small number of schools that participated infers that the program did not have these characteristics—at least in terms of meeting the needs of schools. Together with the reviewed literature, this proposition led to the development of the following research questions for this study:

Main research question:

Why was the participation rate in the UnIChe school outreach program so low?

In answering this question it is important to consider not only attributes of the program itself and issues from within the university environment, but also constraints from within the school context that may form barriers to participation in such programs.

The corollary of this question is: in what way could the participation have been increased? The answer to this question is actually what will be of most use for informing universities planning outreach.

The main research question will be answered by addressing the sub questions.

Sub questions:

(a) Why did schools, or more specifically teachers, choose to participate in the program?

Not every outreach program on offer will be accepted by a school. Therefore teachers employ a process of prioritisation when deciding whether or not to participate in a given program. This question explores what program features are attractive to teachers and form a high priority in program participation decisions. It also provides for an examination of why teachers might choose not to participate.

(b) Why did university staff get involved in the program?

This question seeks to identify the university's motivation for running the outreach program, and to identify the challenges university staff face in getting involved in outreach.

(c) What communication issues arose between the university and the schools, and in communicating science to the school students?

Several channels of communication between the university and schools were used at different stages during the UnIChe school outreach program. This question is aimed at exploring what were the most effective means of communication, as well as identifying any problems that arose in communication between the university and schools. It also seeks to identify any issues relating to the way in which science was communicated to students during the visits and identifying who should present outreach programs from universities.

Case study approach

The answers to each of these questions are inextricably linked to the context of the program and the personal experiences, opinions and decisions of the teachers and university staff involved. For example, whether a school participated in the UnIChe school outreach program was ultimately the decision of a teacher; this decision perhaps influenced by various opinions, ideas and experiences of the teacher concerned. The case-study approach was therefore the chosen method of investigation for this study.

Interviews with the key people in the program form the primary source of information. Interviewees included university personnel involved in delivering the program; teachers who had participated in the program; and teachers who had elected not to take part in the outreach program. Logistical and communication information as recorded in reports as well as feedback recorded during the UnIChe school outreach program are also used.

Since the views of each teacher have been shaped by different experiences and circumstances, it was thought that teachers would potentially offer widely varying views. Thus if different interviews produced similar themes in the data, it was assumed that these themes could be applied more generally.

Significance of the study

The RSC is still involved in running school outreach under the auspices of UnIChe. The results of this case study will therefore provide relevant information to the RSC about the UnIChe school outreach program. More generally, it will reveal features of outreach programs that encourage school participation; provide insight into the decision making of teachers, and; identify problem areas in communication between universities and schools and in communicating science to school students.

The study will also provide a platform on which to build further investigations of university-school interaction, enabling universities to implement more effective and mutually beneficial programs of school outreach.

Limitations

This study investigates one particular case of school outreach from a university, and therefore generalisations about programs of school outreach are, by default, limited. Many aspects of this program will differ from other programs, in the way it was organised and run, in the subject and materials it covered, the people involved, and the places and times the program was run. However, by analysing the core issues raised by this case it is anticipated that this study will provide valuable lessons that may assist future programs of interaction between universities and schools to meet their aims.

Perhaps the greatest potential limitation of this study was the long period of time that had elapsed between the time when the program was run and when I conducted the

participant interviews (up to 12 months). Although most people had no difficulty in recalling thoughts and opinions of the program, some finer details sometimes needed prompting.

Thesis overview

A review of related literature forms the second chapter of this case study. It explores the variable motivations for outreach, methods attempting to measure outreach, and other areas of university-school relations that may provide knowledge relevant to school outreach. Communication issues between universities and schools are also investigated. The research questions are presented as they emerge from the literature.

The third chapter describes the research methodology applied. It gives the rationale for selecting a qualitative research method, and describes the instrumentation and methods of data analysis. The chapter concludes with a discussion on the limitations of the employed methodology.

The responses of teachers and university staff interviewed during this study are examined in chapter four. Formal feedback from teachers recorded at the time of the program, as well as logistical and communication aspects of the program as recorded in reports, are also investigated. The chapter presents an overview of the attitudes to outreach held by teachers and university staff as well as the factors that influence those opinions, as identified from the interview and other data.

Finally, chapter five presents the themes identified through the data analysis, in relation to the research questions, and provides recommendations for universities contemplating running school outreach for the purpose of increasing tertiary science enrolments. Areas for further research are also identified, and the limitations of the research conclusions are outlined.

Chapter 2: Literature Review

This chapter reviews literature related to:

1. defining outreach and identifying the motivation for universities to deliver school outreach;
2. relevant lessons from other university-school relationships;
3. the potential impact of school outreach and how to measure outreach; and
4. communication issues.

This chapter highlights the wide range of activities that universities define as outreach, and how these are related to the aims of outreach. It draws on examples from the USA and Australia. Other areas of university-school relations in Australia are explored in the context of what lessons may be relevant to outreach activities. The review also identifies potential impacts of school outreach and how to measure outreach, to give a realistic idea of what such programs can hope to achieve. Finally, communication between universities and schools is addressed. The research questions are presented as they emerge from the literature.

Defining outreach and its aims

> **Outreach (n)** *an organization's involvement with or influence in the community.*
>
> *[Oxford Dictionary of English, Second Edition]*

While the word itself is easily defined, the ways in which outreach is expressed between different universities is variable. Exactly how outreach is interpreted by a university depends on the reasons why outreach is being performed; who the target of the outreach is; and what form the outreach takes.

At its broadest level, outreach can be considered to be the way that a university interacts with its community. Therefore, the relationship of universities with the communities in which they function is a determining factor in guiding the nature of

outreach. In terms of school outreach, this university-community relationship will haven an impact on the way a university relates to schools as a member of that community. It is also important to acknowledge that outreach to schools is just one component of university outreach. To explore school outreach therefore requires an understanding of the underlying motivation for outreach from universities.

Outreach in the USA

In the USA, the land-grant university has a strong tradition of social service[1]. These institutions are concerned with service to the people of their state, nation and the world. The mission of the land-grant university is to combine instruction, research, and outreach, to address the needs of society [National Association of State Universities and Land Grant Colleges, n. d.].

With such a strong social ethos, outreach forms an integral part of university operation. Indeed, many land-grant, as well as state universities, have a department devoted to the coordination of university-wide outreach activities, and many have a strategic plan for outreach [See for example, Auburn University, 1996; Michigan State University, 1993]. The processes of academic promotion at these universities also take the outreach activity of university staff into consideration [See for example, Auburn University, n. d.].

While the aims of outreach differ slightly from one university to the next, three common themes exist:

- the development of mutually beneficial relationships or partnerships;
- engaging non-traditional audiences; and
- serving society.

[1] The so-called "land-grant" universities were created under the Morril act of 1862 which awarded each state an allotment of land to fund a new public university. That legislation supported teaching in areas related to agriculture, military tactics and mechanic arts enabling members of the working classes to obtain a liberal and practical education [National Association of State Universities and Land Grant Colleges, n.d.]. This mission is translated today into a strong tradition of community engagement. There are currently 70 land-grant universities in the USA.

For example, The University of Rhode Island is "committed to working toward the solution of problems of societal concerns through its service, research and teaching outreach activities", and it "forges partnerships... resulting in mutually beneficial relationships..." [University of Rhode Island, n.d., Mission section, ¶ 1–2].

The University of Tennessee describes its community outreach as a "bridge for engaging with our community, debunking the image of ivory tower aloofness so commonly associated with academe" [University of Tennessee, n.d.].

Critical to the aim of building relationships is the idea of mutual benefits for both sides. The University of Colorado, Boulder, asserts that outreach activities "provide reciprocal benefits to both the community and academy" [University of Colorado, n.d.]. It defines outreach as the intersection between the university and the community (see Figure 2.1).

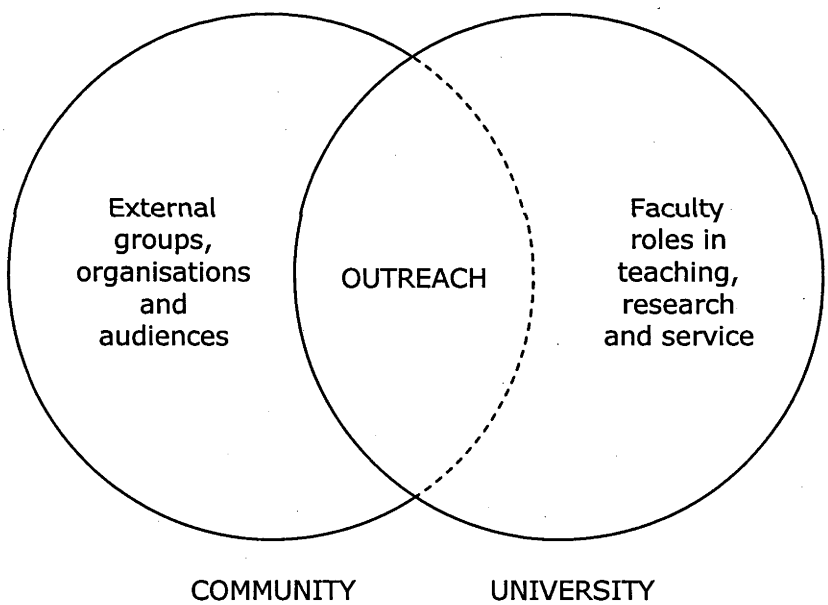

Figure 2.1 Outreach is what joins a university to its community. It involves a reciprocal relationship where each partner has something to offer the other [University of Colorado, n.d.].

Auburn University adds an additional dimension, asserting that when considering outreach activities, the professional development of the faculty member should be

considered in addition to the expected public benefits of the activity, and the mission of the department and university [Auburn University, n.d., Section C. Outreach, ¶ 2].

Outreach to engage non-traditional (i.e. non-student) audiences can involve diverse activities, from schemes to assist disadvantaged groups to attend university, through to free music concerts and public access to libraries. The University of Massachusetts, Amhurst, considers those who engage with the university in such programs as its "hidden student body, the quite literally thousands of individuals who connect in many rewarding ways with the... university every year" [University of Massachusetts, n.d.].

Within this philosophy of community service, school outreach is concerned with broadening the educational experiences of secondary students, beyond what is available to them every day in their classrooms. Literature on school outreach programs, focussing on science and chemistry in particular, reveal five main educational aims:

- to increase scientific literacy in the general public and enhance learning experiences of secondary students;
- to improve perceptions of science and to show that it is fun and has applications in daily life;
- to demonstrate what careers in science involve;
- to motivate learning and awaken curiosity; and
- to provide professional development for teachers in science.

For example, 'Enhancing Tomorrow's Chemists' is an outreach program run by volunteer graduate students from The University of Illinois, which provides curriculum-linked experiments and presentations on such topics as ethics, careers in science, and science in the news [Heinze, Allen, & Jacobsen, 1995].

In South America, the University of Puerto Rico runs a 'Science on Wheels' program, taking hands-on experiments into secondary schools in their community. These schools typically "have limited access to information, science materials, scientific

instrumentation, and hands-on experimentation" [Lopez-Garriga et al., 1997: 1346]. Developing cooperative links between universities and schools is crucial in this case, otherwise: "In addition to promoting a general fear of science, this limitation produces apathetic students and creates the impression that science is open only to the brightest." [p. 1346].

This program also involves workshops for teachers, aimed at giving them an opportunity to develop their science skills and to include science demonstrations in their own classes.

There are also examples of scientists from universities building partnerships with school teachers. Scientist-teacher partnerships are an increasingly popular in science education reform, aimed at strengthening teachers' confidence in teaching science [Tanner, Chatman, & Allen, 2003: 195]. Such partnerships are considered by some to be "essential in increasing the coherency of science education... from the first days of kindergarten through to the undergraduate years" [p. 195].

Very few programs claim to be particularly concerned with motivating students to enrol in science at university, although many consider it may be a positive side-effect: "Although we certainly would be pleased to influence some of our students to pursue careers as scientists, this is not our primary purpose" [Heinze et al., 1995: 167].

Many school outreach activities also target primary school audiences. An example is the University of Wisconsin, 'Scientist-In-Residence' (SIR) program [Kelter et al., 1994]. This intensive one-week program involves immersing every primary student in the school, along with their families and teachers, in curriculum-linked hands-on science activities. Although the program is logistically challenging, the authors believe "an effective SIR program... can be organized by the chemistry-physical science department of almost any college, for presentation at virtually any elementary school" [p. 866].

School outreach programs are targeted at the primary age group because of the belief that "science is still fresh and... an exciting subject for them" [Tracey, Collins, & Langevin, 1995: 1112].

It is evident from these examples that, in the USA at least, there are many different outreach programs in place that appear to be successful. In light of the success of these other programs, the main research question emerges: *"Why did the UnIChe outreach program fail to attract participants?"* If other programs have been successful, what was it about the UnIChe outreach program that led to such a low participation rate? What other issues within schools may have contributed to this? These are the issues to be resolved by the main research question.

Outreach in Australia

University missions

In Australia, serving the community is part of the accepted role of universities. However the social service function of Australian universities is not as uniformly proclaimed as it is by America's land-grant universities. There is a great diversity in the mission statements of Australian universities. Some declare a strong focus on their region and community, while others emphasise their service to industry and the immediate utility of their work [Anderson, Johnson, & Milligan, 1999: 21].

The emergence of private universities, such as Bond University, has even led some to advocate the removal of higher education from the ethos of social service altogether [Watts, cited in Beswick, 1988: 97].

Regardless of this view, universities operate within and as members of the community. Therefore, relationships with community, educational, professional, government, and other organisations, will continue to be of prime importance and outreach activities provide an avenue for these relations.

While not all Australian universities have a separate strategic (or similar) plan for outreach activities, many do recognise the role of outreach in achieving the wider goals of the university.

For example, The University of Western Australia (UWA) seeks to build strong relationships with academic, professional, business and cultural communities, and believes that community service is an integral component of the University's role [University of Western Australia, 2001: 12].

The University of Melbourne recognises serving wider communities in its strategic plan, through its goal:

> To serve Victorian, Australian and wider regional and international communities through welfare programs, cultural activities, educational, scientific and artistic developments, and by promoting informed intellectual discourse and political debate [University of Melbourne, 2003: 51].

Strategies to fulfil this goal are varied, and include the involvement of university teams in major sporting events; working with indigenous Australian communities to meet their social and educational needs; strengthening links with Victorian schools, and; encouraging academic staff to engage in public debate [p. 51].

With a slightly different emphasis, service to the community also forms a main goal within the strategic plan of the University of Sydney:

> By providing knowledge, opportunity and encouragement, the University of Sydney will maintain and enhance its position as a leading contributor to the opinions, ideas, cultures and lifestyles of the many communities it services locally and internationally. [University of Sydney, 1998: 28].

Outreach activities in support of this goal include working with local government to address local environmental issues; encouraging and supporting academic staff to speak in the media; and developing links with local schools [p. 29].

Some universities also acknowledge their dependence on the communities which they serve. According to the University of Adelaide, the community makes a critical contribution to the fulfilling of its goals as well as playing a role in judging the success of the university [University of Adelaide, 2001: 2]. The UWA also recognises that it "...must continue to publicise and build upon its achievements in the community so that its value to the society on which its future depends is fully appreciated" [University of Western Australia, 2001: 7].

The three traditional university roles of teaching, research and service are still widely accepted core functions among Australian universities. However, community service is

absent as a core function in the ANU strategic document, *ANU to 2005* [Australian National University, n.d.-a]. And while the ANU aims to have an "effective and broad program of community outreach", this forms a small part of a tactical goal to "support... the core activities of research and education..." [p. 15].

This is not an exhaustive list of the missions of all Australian universities; it does serve as an example, however, of the variability of importance placed upon community service by Australian universities.

Given this variation, how do the missions of universities affect the institution's stance on outreach? If there is no institutionally adopted "party line" on outreach, how and why do staff engage in delivering such programs? How does this affect the aims of outreach programs? To gain insight into these issues, the research sub-question was developed: *"Why did university staff get involved in the UnIChe program?"*

Motivation for outreach

Within this variable community service environment, school outreach activities from Australian universities also vary considerably. Focusing on science, a number of universities go as far as housing science museums, such as the Monash Science Centre at Monash University [Monash University, n.d.], and the Edward de Courcy Clarke Geological Museum at UWA [University of Western Australia, n.d.]. Although never housed at the university itself, Questacon—the national science and technology centre, originated through the efforts of Professor Mike Gore at the ANU [Gore, 2001].

The Faculty of Science at Sydney University has quite a comprehensive program of school outreach. Through their "Science Alliance" program, the University offers information and activities for school students, teachers and parents; HSC assistance is offered through the "Kickstart Science" program; and school groups are invited to visit the University and participate in science shows or have them performed at their schools [University of Sydney, n.d.].

School outreach is also strong at the University of New South Wales (UNSW), which operates an Outreach Centre for Science (OCS) through its Faculty of Science. The aim of the OCS is "to promote an understanding and awareness of the sciences amongst school students and the community" [University of New South Wales, n.d.]. The OCS

acts as a hub for outreach activities offered by the departments within the science faculty. Such activities include a program of science shows for schools; campus tours; fortnightly Friday night science events; and the publication of a science magazine for school-aged children. Teacher resources linked to the curriculum are also offered for secondary science teachers, as well as information relevant for school careers advisors.

In contrast, outreach from the ANU is less centralised. A few programs are offered from the various science areas, such as the "Adopt A Physicist" program from the National Institute of Physical Sciences [Australian National University, n.d.-b], or the UnIChe school outreach program being studied here. There is, however, no single contact point through which schools can access these programs, as there is for UNSW and the University of Sydney.

Recalling the main aims of outreach in the USA:

- the development of mutually beneficial relationships or partnerships;
- engaging non-traditional audiences; and
- serving society;

and more particularly, the educational aims of science-based school outreach:

- to increase scientific literacy in the general public and enhance learning experiences of secondary students;
- to improve perceptions of science and to show that it is fun and has applications in daily life;
- to demonstrate what careers in science involve;
- to motivate learning and awaken curiosity; and
- to provide professional development for teachers in science.

It seems that, in contrast to these aims, more commonly (although not exclusively) outreach activities from Australian universities are applied solely to encourage student

recruitment. With around 50% of university intake coming from school-leavers, and around 60% for science, secondary schools are the single largest source of students entering university [Dobson & Calderon, 1999: 38-39]. Therefore, outreach of this kind is largely concerned with secondary students and those who influence them, such as teachers and parents [Harvey-Beavis & Robinson, 2000: 20].

Examples of such recruitment outreach activities can include university open days and school visits. While these activities do offer some benefit to prospective students (such as providing course information) they generally do so in order to influence students' decisions to study at a given institution. For example, in a study of university open days, Pickford (1991) is appalled at the concentration held in the period leading up to the enrolment application closing date:

> I find it disturbing that so many universities should want to interact with their communities a few weeks before the closing date for applications to enrol [p. 335].

A scan of Australian university open day information on the Internet reveals that almost all are still held in the months of August and September. While there is some evidence of open days being held for universities to engage more widely with their communities, [For example: University of Adelaide, 16 August 2001; Newcastle University, 16 June 1999], more recently they concentrate on offering information primarily for potential future students and their families, not for communities more generally. More novel approaches are taken by the University of Technology Sydney, which offers a "Virtual Open Day" online [University of Technology Sydney, n.d.], and Charles Sturt University which proclaims "Open Day, Every Day" [Charles Sturt University, n.d.].

At a time when the variety of courses and institutions on offer is greater than ever, there is certainly a need to provide information to prospective students in order for them to make informed decisions about tertiary study, and to be aware of the implications of their choices. As stated by Baldwin and James (2000):

> ... there is an urgent need for young people to receive more specific information about the nature of the broad fields they are considering, the kinds of careers these lead to, and the career prospects in those fields... [p. 146].

Whether this information should be provided by the universities themselves or from some independent source is debatable, but Baldwin and James believe that it should be a program run nationally by the Commonwealth Government.

Some regional attempts at providing this service have been made. In Queensland, the Tertiary Entrance Procedures Authority, (now the Queensland Studies Authority) launched a Secondary-Tertiary Links Program to facilitate the relationship between the sectors in rural areas and to develop useful information for students about tertiary options. The program, implemented in 1994, still runs today, no doubt buoyed by a review held in 1997 that determined the existence of a regional link coordinator was helpful, and that secondary-tertiary links had improved in regional areas [Whitely, 1997:5].

Given the dependence of university intake upon secondary students, especially in science, the relationship between universities and schools is undeniably important. Anderson et al. (1999) recognise this in a report on strategic planning in Australian universities:

> Schools are important as the chief source of students, and in planning for growth or improved quality a university may need to cultivate close relations with particular schools or classes of schools. It is not simply a matter of good public relations [p. 10].

Despite this, they report that few universities mention the alleged decline of science in secondary schools in their strategic plans, and there is almost no discussion of the relationship between school and university education [p. 19].

In reality, community outreach and recruiting activities are not mutually exclusive. As argued by Pickford (1991), the outcomes of community outreach often overlap with the aims of recruitment outreach; but he stresses that the motivation behind such activities can alter their success:

> I... plea with universities not to hold open days in order to recruit more or better students. That will happen anyway. Hold them because you want to make the community your partner... If your motives are selfish, or even perceived to be selfish, you will not succeed [p. 334].

Considering the motivation for outreach is a concern also to be addressed by the research sub- question: *"Why did university staff get involved in the UniChe program?"* Ascertaining the reasons for staff involvement will shed light on the wider motivation of the University for conducting outreach.

Other university-school relations

There are several other avenues of university-school relations. Two are discussed here: teacher training and equity programs. Some of the issues in the literature on these areas which may provide insight into school outreach are highlighted.

Teacher training

While school outreach from universities is relatively new, the professional partnership between schools and universities in the area of pre-service teacher education is comparatively well established. Teacher training clearly bridges both school and higher education sectors, with universities providing the theoretical training ground, and schools providing the venue for practical implementation.

The development of professional programs promoting partnerships involving universities and schools flourished under the 1993 Teaching Accord in Australia; an agreement between the Australian Government, Australian Education Union and Independent Education Union [Peters, 2002: 229]. During the period 1994–1996 substantial funding was also offered by the Department of Employment Education and Training (DEET) to support the National Professional Development Program—a program designed to develop Australian schoolteachers through collaborations between educational authorities, universities and teacher organisations. Although such partnerships were not completely new, they became more common as a result of the program [Grundy et al., 2001: 204].

Extensive research into the challenges of such educational alliances, as well as the features of successful ventures, has been conducted over the past few decades. Some of

the themes identified by this research that could also be relevant to the university-school outreach relationship are explored below.

Lack of recognition

The conditions that exist within the institutions engaged in university-school partnerships can adversely affect such relationships. University academics engaged in teacher education may be discouraged by the low regard of teacher education and a lack of rewards for those academics involved in practical school-based activities, compared with those in research, consultancy and publication [Peters, 2002: 229-230]. If school outreach is held in a similarly low esteem by universities, and is inadequately recognised by the reward structure of universities, then academics may be discouraged to become involved in school outreach activities.

'Ivory tower' perception

A lack of credibility, arising from the perception that those in universities are theoretical and out of touch with schools, can form an initial barrier to university academics winning acceptance from schools [Peters, 2002: 231]. Smedley (2001) believes that some research by tertiary writers serves to reinforce teachers' documented views on the distance between 'ivory towers' and 'the chalkface' [p. 198]. This is exacerbated by the fact that relationships between universities and schools have historically been quite unidirectional, with greater emphasis placed upon the high status of universities and little regard or acknowledgment for the expertise held by school teachers [Tanner et al., 2003: 196].

If universities approaching schools in outreach programs seem aloof to the needs of the classroom or fail to acknowledge expertise within the school, then this ivory tower perception could also affect the credibility of academics in the university-school outreach relationship.

Differing values and goals

In a study of the Innovative Links Project, a professional development program that was designed to provide partnership opportunities for teachers and university associates, Peters (2002) identified that school and university participants valued

different aspects of the partnership. University participants were more likely to value a more rigorous (and potentially lengthy) developmental process, whereas schools were more interested in solving immediate practical problems [p. 232]. In the university-school outreach relationship, the ability of the university to meet the immediate needs of a school, such as meeting curriculum outcomes, may be judged to be more important than any longer term goals the university may have for the program.

When it comes to the benefits of the university-school relationship, Peters believes that it is the schools that are most often considered; benefits to the university are often purely incidental. She suggests the solution may be to identify separate goals at the start of a collaborative alliance [p. 235]. This measure could potentially be relevant to the university-school outreach relationship to ensure the goals of both the university and schools are addressed.

Time

Time constraints can also pose a challenge to school-university links. Smedley (2001) identifies two aspects of time as important, firstly the longitudinal nature of the partnership. A partnership doesn't develop the instant that a committee decides to adjust, recreate or pilot a program, and impatience is often shown when success is not evident within a period as short as a year. And while university-school outreach relationships are really only just beginning to take off, the relatively well-established partnership relating to pre-service teacher education is itself only in its infancy in terms of trying to identify the success or otherwise of such programs [p. 197].

The second aspect of time is the finding of free periods to attend to the needs of the partners. Smedley believes that time for developing and nurturing a partnership is dependent upon adequate resources for all participants (i.e. time and effort needs to be invested by all partners and this has to be recognized by the system). It is this aspect which is identified as the over-riding concern which threatens the success of partnership development. Donated labour of the partners may be the only way that genuine partnerships are possible [p. 197]. For academics, the need to serve two masters—the academy and the school—is noted as an increasing concern especially where lecturers feel undervalued by both [p. 199] and frustration can result from involvement in multiple partnerships on multiple sites.

Research which explores the features of successful partnerships, identify a number of common themes.

Grundy et al (2001) found that in order to build genuine partnerships and honest collaboration, the development of trust among participants and the recognition and satisfaction of the distinctive interests of all parties is important [p. 205].

Woodward and Sinclair-Gaffey (November 1995) identified that communication, liaison and cooperation between partners is important, as well as the mutual benefit derived [Evaluating the School-University Partnership section, ¶ 5].

Peters (2002) found that it is particularly important for university partners to have outcomes that are recognised within the university reward structure [p. 239].

The idea of mutual benefits and of outcomes that are recognised for reward is evident in Peters' (2002) claim that it is important that the roles played by the university participants in collaborative research should be negotiated by participants, rather than imposed by project expectations [p. 232].

The issues highlighted here point to two areas to consider in answering the main research question: the characteristics of the program and its delivery, as well as challenges within the environments of the university and schools involved. As it is the university initiating the outreach, a main concern is to determine what aspects of the school environment may affect participation in outreach activities and what program characteristics are most appealing to schools. This lead to the development of the following sub-question to the main research question: *"Why did schools, or more specifically teachers, choose to participate in the UniChe program?"*

Equity Programs

Universities have also conducted outreach motivated through Government initiatives to encourage participation of disadvantaged groups in higher education. For example, the LINK programs, funded under the Commonwealth's Higher Education Equity Program, were established at five Australian universities and colleges in 1989. The

participating institutes were Hawkesbury Agricultural College, Monash University, Chisholm Institute, the University of Newcastle and the University of Wollongong.

Six groups were targeted under the program: people from economically disadvantaged backgrounds, Aboriginal and Torres Strait Islander people, people from rural and isolated areas, people with disabilities and women (in regard to areas of study not traditionally sought or available to them). The strategies adopted by the different LINK institutes for each target group varied, but all involved developing more personalised and interactive relationships than basic tertiary awareness programs [Knight, Kyle, Wright, and Shaw, 1993: 15].

A review of the program in 1993 identified the important role played by enthusiastic individuals in the overall success of the program. It also found programs were most successful in the cases where they were run within a larger unit, enabling programs to be placed in the context of broader institutional goals and to access administrative and academic infrastructure and resources. This latter point is considered important in ensuring the long term feasibility of the program once seed funding had ceased [Knight et al., 1993: 95].

With regard to evaluation, Knight et al. (1993) consider it "vital that procedures be put in place at the beginning of the program to assess its effectiveness in meeting its objectives" and suggests both qualitative and quantitative information be collected [p. 98].

The review also found when examining the motivation behind the setting up of the LINK program in each institution, that there was in each case some conflict between educational equity objectives and the more self-interested aim of marketing [p. 96]. As it turned out, those programs that tended to concentrate on marketing did not survive, and Knight et al. (1993) suggest that "objectives which are broad in scope seem necessary to the continuation of programs such as LINK, especially when circumstances and policies are changeable" [p. 98].

Regarded as one of the most successful among the LINK institutes, the University of Wollongong (UOW) program became a mainstream University-funded activity once the government seed funding of the pilot program ended. Interestingly, outreach has become a crucial part of the UOW core strategy, with a strategic plan for community

engagement as "a major platform for achieving University Strategic Goal 6: productive engagement with our regional, national and international communities", [University of Wollongong, 2004, Introduction].

The point of motivation for running outreach is again made, this time in relation to the longevity of a program and how such programs sit within the larger objectives of the university. This theme is to be explored under the research sub-question, *"Why did university staff get involved in the program?"*

Impacts of outreach

Even if an outreach program from a university is able to meet all of these challenges and has all the right characteristics for building a strong and lasting partnership with secondary schools, what is the likely impact of the program upon students' decisions to study science at university?

In a report commissioned by DETYA to investigate the factors that influence the choices of prospective undergraduates, James, Baldwin and McInnis (1999) identify a number of information sources of varying influence. They found that for school-leavers, materials given out by careers teachers were the most used and most influential sources of information. University open days were also a major influence. School visits to universities were used by a much smaller proportion of applicants, but were influential for those who participated in such visits [p. 15].

School outreach programs, as being investigated in this thesis, are not represented, probably due to the scarcity of university visits to schools and other such outreach activities. This invites the question of whether the more influential sources of information are simply more readily available than some of the other less cited factors. If more schools made visits to universities, more students may report this as a major influence, for example. On the other hand, James et al. (1999) found that sources such as university websites, newspaper advertisements and articles ranked relatively lowly, despite presumably being widely accessible.

It may simply be a question of trust; in a later study on the views and influences of secondary students in relation to tertiary education, Harvey-Beavis and Robinson (2000) identify that significant people in students' lives can influence their decisions—

careers teachers and family members among them [p. 20]. So perhaps a student is more likely to listen to advice from a careers teacher who is known personally and trusted, rather than an overt attempt by a university to win them over through advertising, or an article written by an unknown journalist. It may be that information is best directed at careers teachers, who will then provide it to their students.

When it comes to choosing a field of study, James et al. (1999) identify four dimensions of influence: personal interest in the field including career options; employment prospects; impression of the field; and access to and advice from others. The main motivation for school-leavers comes from the first of these, with students exploring areas that interest them and in which they believe they have some ability or talent [p. 18]. This is complementary to Harvey-Beavis and Robinson (2000) who highlight that the educational experiences and achievements of students influence their tertiary choices [p. 17].

This leads to the issue of improving the educational experiences of students in science, which in turn is linked to teacher education in science and to outreach programs that enrich the science experiences of secondary school students. Clearly, understanding the potential impact of outreach is no simple task.

Given the large number of factors identified in the literature that influence the decisions of secondary students, perhaps the most that can be concluded is that outreach programs can potentially make some impact. This may be through as simple a means as providing information about specific courses and career opportunities to prospective students, to more complicated and long-term strategies to improve the confidence of teachers of science and provide better learning experiences for students.

What impact the UnIChe program may have had upon students is not easy to ascertain, but it is hoped some insight will be gained in answering the research sub-question, *"Why did schools participate in the program?"* The longer-term effects will be difficult, if not impossible, to gauge; and given the short life of the program at the time of this research, the expectation for having achieved any long-term impact must necessarily be small.

Measuring outreach

Measuring outreach involves two distinct parts: quantifying the resources and efforts that go into outreach activities at a university; and evaluating the effectiveness of those activities. There are few examples in the literature of universities measuring their outreach activities from either of these perspectives, although some do exist.

For example, Michigan State University has devised a tool they call the Outreach Measurement Index (OMI), to gather institution-wide information on outreach activities. The purpose of the OMI is:

> To define consistent quantitative measures that can be used both to describe the whole institution's investment of resources in engagement activities and to establish expectations of what individuals and units should contribute to meeting the institution's outreach or engagement mission. [Church, Zimmerman, Bargerstock, and Kenney, 2002/03, Introduction, ¶ 3]

The OMI is a survey tool that contains three parts, two requiring largely quantitative data, while the third encourages more detailed anecdotes about the respondents' outreach work. The tool is designed to collect a variety of information that can be used as a management tool for the planning and allocation of resources and as documentation to better enable outreach to be counted for academic reward [Church et al., 2002/03].

The first section asks respondents to estimate the total percentage of their time spent on outreach work, which may overlap with other activities. Church et al. (2002/03) believe this is the single best measure of institutional commitment to outreach, since faculty time is the most valuable resource a university has.

The second section asks respondents to characterise the outreach activities in which they are involved. The aim is to quantify where and on what types of activities university outreach resources are being spent and what groups are benefiting. Earlier versions of the OMI sought detailed financial information relating to the investment of resources into outreach work, but as Church et al. (2002/03) relate, "faculty either resented such a heavy emphasis on monetising activity that they consider socially

rather than economically driven or were unable to estimate the costs of carrying on the activity" [Church et al., 2002/03, Outreach Measurement Index, ¶ 7].

The third section came largely in response to the demand from some faculty that "efforts to quantify outreach effort ignored, even suppressed, what is unique and important about outreach" [Church et al., 2002/03, Outreach Measurement Index, ¶ 8]. This section provides opportunities for respondents to describe the importance of their work, including outcomes and any formal evaluation they may have conducted.

At Auburn University, the broad range of activities defined as outreach are a recognised part of the promotion criteria for faculty, and therefore "demands for quality in outreach are the same as in teaching and research/creative work" [Auburn University, n.d., C. Outreach, ¶ 3]. However the university recognises that outreach activities differ from these other activities, and a system to measure outreach is needed.

The strategic plan for university outreach at Auburn University recommended the adoption of "operational outcomes", which "identify the real-world outcomes that should be detectable if outreach impact is claimed" [Auburn University, 1996, Outcomes section, ¶ 1]. These are big-picture, utopian, and entirely unmeasurable outcomes, such as "enlightened citizens, liberally educated across the lifespan", and "educated professionals and skilled workforces".

While these ideals would be a welcome outcome of effective university engagement with the community, they offer little in terms of how to assess faculty outreach for consideration in reward, promotion, and ultimately, tenure, or to what degree the outreach has achieved its aims. More practical criteria were developed by a University steering committee assembled in response to this issue. The result was a pro-forma designed to capture the objectives, deliverables, resources, and both qualitative and quantitative impacts of the outreach activity [Auburn University, 1997: Appendix 2].

In trying to measure the input and outcomes of the UnIChe school outreach program, the time and cost invested need to be considered, along with the impact the program had on each of the partners—the university and the schools. In terms of time and money invested, information from UnIChe reports can be used. Gaining a measure of the outcomes will be more difficult and largely subjective. From the university's

perspective information will come in the answer to the research sub-question, "*Why did university staff get involved in the program?*" Insight into the schools' perspective will come from answering the research sub-question, "*Why did teachers choose to participate in the program?*"

Communication Issues

During an outreach program communication between universities and schools takes place at several different levels.

At the institutional level, the communication between universities and schools may be hampered by a number of issues. As mentioned in an earlier section, the perception of schools that universities sit upon 'ivory towers' can lead to unequal relationships which can in turn obstruct communication.

The professional environments of teachers and of university research staff can differ greatly. Tanner et al (2003) suggest this 'uncommon ground' results in differing communication styles which can impede communication between schools and universities if not recognised [p. 198].

At a personal level, language itself can become a barrier. When scientists from universities interact with secondary students and teachers in outreach activities, they must be careful not to slip into using specific vocabulary, nomenclature or jargon that is most likely not going to be understood:

> In addition to the more sceptical communication styles of scientists and the more encouraging communication styles of teachers... even phrases and single words can present challenges [Tanner et al., 2003: 199].

The third research question is designed to elicit the communication issues faced during the program at both the institutional and personal level: "*What communication issues arose between the university and the schools, and in communicating science to the school students?*"

Summary

More and more, universities are 'outreaching' beyond the tertiary sector, into schools and other areas of the community, in various ways and for various reasons. In its

broadest sense, outreach is the relationship between a university and its community. The aims of outreach generally stem from the missions of the universities themselves and are linked inextricably with the nature of the university-community relationship.

This relationship is played out in many different ways and with varied motives, from providing service to the community, through to marketing and recruitment drives. These activities can benefit both the community, including schools, as well as universities. In terms of addressing declining enrolments in science, the influences on secondary students' decision making are complex. School outreach can potentially make some impact, through as simple means as providing information to prospective students, to more complicated and long-term strategies to improve the confidence of teachers of science and provide better learning experiences for students.

Universities engaging in outreach should seek to measure their outreach activities, both in terms of quantifying the resources and efforts that go into outreach activities at a university; and evaluating the effectiveness of those activities. The best means for measuring outreach will depend on the aim and nature of the activities, but will likely involve both qualitative and quantitative measures.

In respect to the outreach program currently under study, the reviewed literature points to several areas that need to be explored: the university's motivation for running the program; the characteristics of outreach programs that are attractive to schools; aspects within the school environment which may impede participation in outreach; measuring the efforts and results of the program; and issues around communication between the university and the schools.

In light of the literature review, the following research questions were developed:

Why was the participation rate in the UnIChe school outreach program so low?

(a) Why did schools, or more specifically teachers, choose to participate or not in the program?

(b) Why did university staff get involved in the program?

(c) What communication issues arose between the university and the schools, and in communicating science to the school students?

Understanding what prompted teachers and university staff to participate in the program and identifying any problems in communication will, it is hoped, reveal why the participation rate was low, and together with the literature, indicate ways in which the program could be better designed to meet the needs of both partners.

Chapter 3: Methodology

Introduction

The literature review identified that the underlying motivation for running outreach often stems from the strategic missions of the universities themselves. To understand how this might translate into the motivation for the UnIChe program, it was important to consult those involved in running the program, about their ideas of the university's motivation and of their own reasons for being involved in the program. It was also important to gauge the impetus for schools to participate in outreach programs from universities, to gain an understanding of why the UnIChe program failed to attract a large participation from schools. Determining the contribution that communication issues between the university and the schools may have made was also considered vital to this understanding.

This chapter gives the rationale for selecting a qualitative research method, and describes the instrumentation and methods of data analysis. The chapter concludes with a discussion on the limitations of the employed methodology.

Research methodology

The following research questions were developed as detailed at the end of Chapter 2 on pages 37–38:

Why was the participation rate in the UnIChe school outreach program so low?

(a) Why did schools, or more specifically teachers, choose to participate or not in the program?

(b) Why did university staff get involved in the program?

(c) What communication issues arose between the university and the schools, and in communicating science to the school students?

The reviewed literature points to several areas that need to be explored: the university's motivation for running the program, the characteristics of outreach programs that are

attractive to schools, aspects within the school environment which may impede participation in outreach, measuring the efforts and results of the program, and issues around communication between the university and the schools. It is hoped that understanding what prompted teachers and university staff to participate in the program will reveal why the participation rate was low, and together with the literature, indicate ways in which the program could be improved.

Each of the research questions was addressed through qualitative research methods. According to Creswell (1994) the nature of the research problem is an important factor in determining the suitability of quantitative or qualitative approaches. He suggests that where little information exists on the topic, where the variables are largely unknown, and the context may shape the understanding of the phenomenon being studied, a qualitative approach is indicated [p. 10].

From the review of literature, it is clear that very little research exists on university-school outreach programs, particularly in Australia, where the concept of outreach is not nearly as mature as in the United States. The relative immaturity of the topic and the explanatory nature of the study lend itself to a qualitative research design.

Within qualitative research methods, Yin (1994) suggests that case studies are preferred when such "how" or "why" questions are being posed, because they deal with "operational links needing to be traced over time, rather than mere frequencies or incidence" [p. 6]. Histories or experiments can also be applied to such questions; however, a focus on contemporary events, and a lack of control over the actions and behaviours being studied, effectively rules these out in the current study.

As a method of research, the case study is used in many and varied situations, especially where there is "... the desire to understand complex social phenomena" [Yin, 1994: 3].

The complex nature of the university-school relationship has been indicated in the literature. This case study seeks to explain that relationship through asking why the UnIChe program failed to attract participants and to determine what extent communication and other issues played a role.

Many types of information may be used in a case study. Yin (1994) outlines six important sources of evidence in case study research, and offers the strengths and

weaknesses of each. These sources are: documentation, archival records, interviews, direct observations, participant observation and physical artefacts [p. 80]. He notes that no one source is better than any other; all are in fact complementary, and he argues therefore that a good case study should include as many of these sources as possible.

It was considered that interviews of the key university staff involved in the program, as well as teachers who had chosen to participate in the program, and others who had chosen not to participate, would deliver the greatest insight into the factors being investigated by the research question. According to Yin (1994), interviews are an essential source of case study evidence, and may be open-ended, focused, or of a more structured survey format [pp. 84-85]. A survey was not considered capable of providing the adequate depth of information required; instead a series of focused questions were designed to keep the interview conversational to allow the interviewees to provide a fresh commentary on the program being investigated.

Documentary evidence was also consulted, including UnIChe reports, but these were used largely to "corroborate and augment evidence from other sources" [Yin, 1994: 81]. Some direct observations and quantitative survey data recorded during the program also supplement the primary interview data.

Using multiple data sources serves to enhance the validity of research findings through data triangulation. Traditionally the most important advantage of such an approach is the development of "converging lines of inquiry", giving much greater conviction and accuracy to any case study finding or conclusion since it is based on several different sources of information [Yin, 1994: 92]. As pointed out by Mathison (1998) however, such a convergence of evidence is not realistic; instead she places a greater onus on the researcher, describing triangulation as a technique in which the investigator must make sense out of data that may be inconsistent, divergent and contradictory. In Mathison's view, triangulation "provides more and better evidence from which researchers can construct meaningful propositions about the social world" [p. 15].

Instrumentation

Interviews were held over a two week period at the end of June and beginning of July 2003, with three held in a few days in September 2003; in some cases more than a year after the program under study was conducted. Some interviews were carried out in

person—those with university staff; the majority however, were held over the telephone due to the large geographic distribution of the interviewees.

The period of time between the program being studied and the actual interviews is perceived to have some potential disadvantages, since it may be difficult for interviewees to remember precise details after such a time lapse. Most interviewees, however, had no trouble remembering events, although some aspects needed prompting in a few cases. Many of the questions pertained to the interviewees' attitudes and opinions on particular topics; and while these may change over time, the opinions given were taken to represent their view at the time of interview.

The interviews consisted of questions specifically regarding the UnIChe outreach program and about outreach more generally. The questions varied between the interviewee groups, although there was much overlap. Questions asked of teachers aimed to draw out the factors that influenced them to participate in the program (or what may have deterred them if they chose not to participate); to find out what their attitudes towards outreach are; and to gain an understanding of what teachers value in such programs. With the university participants, questions tried to delve into their personal reasons for taking part in delivering the program, and to elicit their opinions about the broader reasons that both universities and schools engage in outreach (See Boxes 1a–d on pp 43–44).

Although the questions were ordered to allow a logical flow of topics, the question sequence was not strictly adhered to, and often further probing questions were introduced; where particularly interesting comments were made on a topic, or if a slightly different line of enquiry was deemed necessary to obtain the information being sought, then the interview was adapted to accommodate these needs. As suggested by Holstein & Gubrium (1995) a growing background knowledge derived from previous interviews—knowledge of emerging themes and also of particular words and terminology used by respondents— was also drawn upon to pose further questions and explore interviewee responses that otherwise would not be probed [pp. 45-46].

Box 1a: Questions asked of all interviewees

About school outreach in general:

1. What benefit to schools do you think outreach programs from universities provide?
2. What benefit do you think such programs provide to universities?
3. What attributes would attract your participation in a school outreach program?
4. What aspects of a school outreach program might deter you from participating?
5. What difficulties exist in participating in outreach programs?

Box 1b: Questions asked of teachers who participated in UnIChe

About the UnIChe outreach program:

1. What attracted you to participate in the outreach program?
2. Did you find participating in the program was difficult?
3. The outreach team visited your school in [month]. Was this a good time of year for such a visit to occur?
4. Do you think that participation in the program was worthwhile?
5. What benefits do you think the students gained through participating in the program?
6. What are your views regarding the style and content of the program?
7. Are there any other comments regarding the program that you would like to make?

Box 1c: Interview questions for teachers who did not participate in UnIChe

About the UnIChe outreach program:

1. What deterred you from participating in the outreach program?

About school outreach in general:

2. Have you ever participated in any kind of school outreach program from a university?
3. In your opinion is there a time of year that is particularly suitable for programs such as these to visit schools?

Box 1d: Interview questions for university staff who administered UnIChe

About the UnIChe outreach program:

1. What influenced your decision to be involved in the outreach program?
2. What difficulties did you experience through being involved in the program?
3. Did you find participating in the program a worthwhile experience?
4. In your opinion was the program well received by teachers and students?
5. Are there any other comments regarding the program that you would like to make?

About school outreach in general:

6. What benefit to schools do you think outreach programs from universities provide?
7. What benefit do you think such programs provide to universities?
8. What do you believe is the role of university staff in administering school outreach programs?

Approval to conduct the research was then sought from the Human Research Ethics Committee within the Research Services Office of the ANU. Approval was granted under Protocol 2003/37 on 16 April 2003 (see Appendix A). Following ethics approval, letters were sent to teachers at the fifty schools originally invited to participate in the UnIChe outreach program, to seek their participation in the research. The letters were addressed either to the teacher with whom contact had originally been made—as in the case of the fifteen schools visited during the program—or else the head science teacher. The letter outlined the purpose of the research, and invited the recipient to contribute through an interview that would be recorded for later transcription. A consent form was enclosed (see Appendix B), and the respondents were asked to sign and return the form if they chose to participate in the research, and to nominate if they agreed to be quoted and identified in the sub-thesis. The consent form offered the opportunity for the respondent to remain anonymous, and for their comments to be suppressed in the thesis; however all of the interviewees agreed to be identified and quoted without restrictions.

All recorded interviews were transcribed fully and included in the analysis and subsequent interpretation. Each of the interviewees was then given the opportunity to comment on and modify quotes attributed to them.

Sample population

As described in the preceding section, letters requesting interviews were sent to fifty schoolteachers in the ACT and five regional districts of NSW (Queanbeyan, Batemans Bay, Shell Harbour, Wagga Wagga and Griffith—refer to Figure 3.1). These teachers were from schools originally targeted in the UnIChe school outreach program. Of these fifty teachers, just seven returned the enclosed consent form and agreed to be interviewed. A further two teachers responded but declined to be interviewed as they had moved on.

Of the four university staff involved in administering the 2002 UnIChe school outreach program, only two were available to be interviewed.

In all, nine interviews were conducted. Of the school teachers, four participated in the 2002 UnIChe school outreach program, while the remaining three did not. Each of the ACT and NSW regional districts are represented by one teacher, with two from the

Batemans Bay district. Three teachers are heads of science; one is head of agricultural science; and one teacher each of chemistry, general science, and careers.

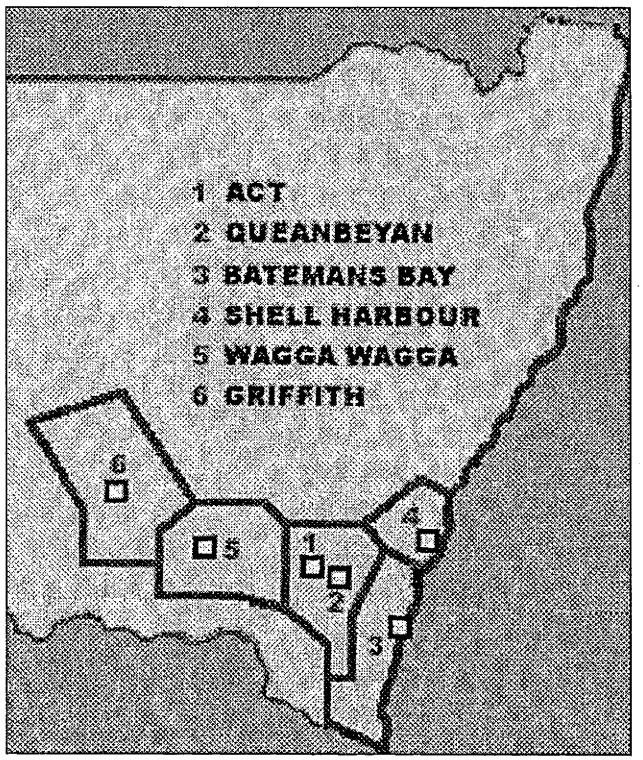

Figure 3.1. Map showing the ACT and five NSW districts in which schools were invited to participate in the UnIChe school outreach program. Schools in the Queanbeyan and Goulburn areas were considered part of the ACT district. [Figure 1 from Fountain, 2002: 4]

The sample population was considered to be a fair representation of the population invited to participate in the research: participant and non-participant schools, city and rural schools; high schools and colleges; large and small schools; head science, staff science and careers teachers were among the sample. In principle the inclusion of all fifty schools in the sample would possibly lead to further insights, but would have been a task beyond the scope of this thesis. The views represented by the small sample included in this study, although limited, still provide important information about the program under study.

Data collection procedures

Following the letter inviting the recipient to participate in the research, those who agreed to be interviewed were contacted by phone to arrange a suitable interview time.

All interviews, except those with the three university staff, were held over the telephone.

The interviews took between 15 and 25 minutes to complete. All consent forms had been completed prior to each of the interviews and all agreed to allow the interview to be recorded. It was decided to tape the interviews to allow a full transcription of each interview to take place. Some notes were taken during the interviews, but as pointed out by Silverman (1993), "they cannot offer the detail found in transcripts of recorded talk" [p. 117].

Transcription took place as soon after each interview as possible. A typical transcribed interview is shown in Appendix B. A three-column format is used, with the transcription in the left column, the centre left empty for notes, and the right column used for attaching codes to the data. The method of coding the interviews is described in detail in the following section.

Data processing and analysis

There is no single correct way to process and analyse qualitative data; a result of the extremely diverse nature of the data used in qualitative studies. However, in case study research, data analysis traditionally involves "examining, categorising, tabulating or otherwise recombining the evidence to address the initial propositions of a study" [Yin, 1994: 182]. It requires the researcher to be "comfortable with developing categories and making comparisons and contrasts" and to be "open to possibilities and see contrary or alternative explanations for the findings" [Creswell, 1994: 153].

From the first interview, the transcripts were examined in an iterative process. The transcript was first read to get a sense of the whole interview. During the second reading, segments of text that seemed important, interesting or unusual were underlined, and some notes made. Even after the first few transcripts, themes progressively began to emerge, and these were kept in mind during subsequent interviews, allowing further questions to be asked if these topics arose during the interview. In this way, data analysis was conducted simultaneously with data collection, allowing the emerging themes to shape further data collection.

After each new transcript was analysed, earlier transcripts were revisited in a process of constant comparisons and refining of themes. Once all interviews were analysed, the resulting themes were consolidated—themes pertaining to similar concepts were grouped together—leaving a number of major categories. These categories were assigned codes, and these codes were then applied to the transcripts. The resulting categories, along with their codes, are listed below:

- Perspectives on the program [PROG]
- School-based issues [SCHOOL]
- Impacts [IMP]
- Past outreach [PAST]
- Communication issues [COMM]
- Characteristics of students [STUD]
- Relationships [REL]
- Attitudes to outreach [OUT]
- Perception of universities [UNI]

The coded data were then tabulated in a simple form to allow comparison of the data obtained from each interview across the different themes, with the aim of identifying both similarities and differences between them. An example of tabulated coded data is shown in Appendix C.

The strategy used to analyse the tabulated and coded data was to follow the theoretical proposition that led to the case study; an approach suggested by [Yin, 1994: 103]. The original proposition stated in Chapter 1 is that outreach programs need to have *certain characteristics* to be "successful"— that is, to satisfy the needs of both partners: the university and the schools.

In the case of the UnIChe outreach program currently under study, the low number of schools that participated infers that the program did not have these characteristics—at least in terms of meeting the needs of schools. This led to the main research question, "*Why was the participation rate in the UnIChe school outreach program so low?*" and the resulting sub-questions.

If it is assumed that the program meets the needs of the university delivering the outreach, the theoretical proposition can be stated in another way: teachers will engage in outreach if the program being offered has *certain characteristics* that meet their own criteria. Formulating the theoretical proposition in this way is useful for analysing the data in this study.

This analytic strategy yielded priorities for what to analyse and why, but is not an analytic technique in itself. Within this strategy, Yin (1994) advocates four dominant techniques: pattern-matching, explanation-building, time-series analysis and program logic models [p. 102].

The pattern-matching logic compares patterns found within the data, with that predicted by the theoretical proposition. If these patterns coincide: "the results can help a case study strengthen its internal validity" [Yin, 1994: 106]. The analytic technique used in this study is explanation-building, in fact a special type of pattern-matching. Explanation-building aims to analyse case study data by building an explanation about the case; that is, to stipulate a set of causal links to explain a phenomenon—in this case, the poor response to the outreach program under study [Yin, 1994: 110].

An important characteristic of explanation-building for case studies is that it is iterative in nature; the final explanation results from a repeated series of comparisons and revisions. As Yin (1994) explains:

> In this sense, the final explanation may not have been fully stipulated at the beginning of a study... Rather, the case study evidence is examined, theoretical propositions are revised, and the evidence is examined once again from a new perspective... [p. 111].

Limitations of method

Inherent limitations of interview data are described by several authors. Creswell (1994) points out that: interviews provide only "indirect" information filtered through the views of the interviewees; interviews provide information in a designated "place" rather than the natural field setting; the researcher's presence may bias responses; and not all people are equally articulate and perceptive [Summarised in a table in Creswell, 1994: 150-151]

Providing some overlap of ideas, Yin (1994) includes such factors as inaccurate responses due to poor recall of the respondent; reflexivity, where the respondent says what the interviewer wants to hear; response bias; and inaccurate articulation [pp. 80, 85]. He suggests that a reasonable approach is to "corroborate interview data with information from other sources" [p. 85], a point already addressed in relation to data triangulation.

Data triangulation, as described earlier, was attempted as a means of providing further validation of the case study conclusions.

This study should be regarded as a base study that could be furthered through subsequent research efforts into university–school outreach that builds on the current data and analysis.

Summary

This chapter described how the nature of the phenomenon under study led to the selection of the qualitative research method, and how the contemporary nature of the problem and "how" and "why" style of research questions, led to a case-study approach. Focused interviews with school teachers and university staff provided the primary evidence for the study. Questions were divided into sections that addressed aspects of the UniChe school outreach program and outreach in general. Out of the 50 teachers invited to participate in the research, only seven agreed to be interviewed; two out of the four university staff involved in the program took part in the research. Interviews with teachers took place over the telephone due to the large geographic distribution of the respondents, while interviews with university staff were conducted face-to-face. All interviews were recorded on audio tape and subsequently transcribed in full. The

interview data was processed iteratively to identify themes and categories which were coded and tabulated allowing comparison of responses for each theme to identify similarities and differences. Following an initial theoretical proposition, the data was analysed using an explanation-building technique with the aim of explaining the poor response to the UnIChe school outreach program. Finally, limitations of the research methodology employed in this case study were described. It was emphasised that although the scope of the study and its conclusions are limited, it could serve as a base study for further research into university–school outreach.

Chapter 4: Research Findings

Introduction

In November of 2001, a school outreach program was piloted as part of a wider project at the ANU called UnIChe. The general aim of the school outreach program was to raise awareness of career options in science, and specifically chemistry, among upper secondary chemistry students. Its primary goal however, was recruitment-driven: to attract the best chemistry students to study chemistry at university—at the ANU in particular.

Encouraged by positive comments from teachers involved in the pilot, the school outreach program was repeated in 2002. At that time, I was appointed to coordinate the program. In this role, I liaised with teachers and university staff to arrange school visits and to present part of the program.

The program received a positive reception from the schools visited, reflected in both formal feedback surveys and in comments made by teachers during the visits. Many teachers expressed interest in participating in future programs. Despite the popularity of the program among the schools we visited, the participation rate in the program overall was less than we had—out of fifty schools invited to take part only thirteen accepted.

The original proposition behind this study is that outreach programs need to have *certain characteristics* to be "successful"— that is, to satisfy the needs of both partners: the university and the schools. Since the program is designed by the university, it *should* meet the university's own needs, so the proposition can be put another way: teachers will only engage in outreach if the program being offered has *certain characteristics* that meet their own criteria.

The low number of schools that participated in the UnIChe outreach program therefore indicates the program did not have such characteristics.

As for determining what these characteristics might be, some indication comes from the literature—but this does not provide all the answers. As emphasised earlier, there is little research on school outreach programs from universities; almost none from within Australia. Some research investigating other areas of university–school relations exists, but school outreach remains largely unexplored.

Research questions

Several data sources were used to address each of the research sub-questions, and these are listed after each question below:

(a) Why did schools, or more specifically teachers, choose to participate or not in the program?

Interviews with teachers and formal feedback surveys

(b) Why did university staff get involved in the program?

Interviews with university staff

(c) What communication issues arose between the university and the schools, and in communicating science to the school students?

Interviews with teachers, interviews with university staff, formal feedback surveys, and coordinator's report

The main research question, "*Why was the participation rate in the UnIChe school outreach program so low?*" was answered through addressing each of these sub-questions.

Each of these data sources are examined in this chapter.

Interviews with teachers

A total of seven teachers were interviewed as part of this study. Four of these were participants in the 2002 UnIChe school outreach program, while the remaining three were not.

The questions asked of interviewees were listed in Chapter 3 on pages 43–44. Participant teachers were asked questions about the UnIChe program, other programs they may have been involved with, and about outreach in general. For non-participant teachers, the line of questioning was similar, but with the aim of exploring the reasons why they decided not to take part in the UnIChe program.

Attractions and dissuasions

When asked what attracted them to participate in the UnIChe outreach program, two of the four participant teachers said there was nothing in particular about the program that had drawn them to it:

> "Nothing specifically [attracted me] about the program. It's just any sort of opportunity to interface with a tertiary institute I see as beneficial to the students" [*From interview with Anne Dynon, Bomaderry HS*]

For one teacher, it is the only program that has ever been offered to his school, so he needed very little encouragement to participate:

> "We don't get access to a lot of things being a rural school. Although things are improving, at that particular point in time there was very few excursions, very few things that we were able to get access to" [*From interview with Brian Huntington, Cootamundra HS*]

The opportunity to expose students to a fresh face and a different point of view was also mentioned among the reasons why these four teachers chose to participate in the UnIChe outreach program.

The overwhelming response from all seven teachers, to the question of what attributes would attract them to participate in an outreach program in general, was a direct relevance to the curriculum they are teaching:

> "Direct relevance to what I have to teach" [*From interview with Bill Needham, Mulwaree HS*]

> "It is important, even if it's not directly in the syllabus but that it be an extension of what we do—a fairly close extension" [*From interview with Lyn Moss, Hawker College*]

> "If it was linked in some way to a couple of syllabus points or outcomes in the syllabus, it would be absolutely brilliant" [*From interview with Paul Werner, Leeton HS*]

Apart from being relevant, teachers said that outreach should also be interesting and stimulating for the students. It should involve the students in experimental work or some other interactive activity that would otherwise not be available to them. Several teachers also mentioned that the material presented should be geared to the students' level and style:

> "It's important to remember that... at tertiary level... it's just a different way of delivering things... The kids, even though they're seniors, or almost seniors, they still like more involvement, something a bit zany..." [*From interview with Anne Dynon, Bomaderry HS*]

All teachers made some reference to their perceptions of the expected impacts of the outreach on the school and their students, in relation to assessing whether or not they would decide to participate in a program or not. The teachers' opinions about the impacts of the UnIChe outreach program and of outreach programs in general are discussed in a later section.

When asked what had deterred them from participating in the UnIChe outreach program, two of the three non-participant teachers did not specifically recall being offered the program. For one of them, the sheer number of approaches of all sorts (not only offers of outreach) made to the school formed at least part of the reason that the UnIChe outreach program didn't particularly come to their notice:

> "On average we get, I think I counted up something like between 70 and 200 such correspondences from all over Australia [each year], and it just gets overwhelming" [*From interview with Bill Needham, Mulwaree HS*]

The third non-participant teacher had actually participated in the pilot phase of the program a year earlier, but had elected not to participate a second time. She was quite

clear about her reasons for this decision. The first was that the presentation topics offered were unchanged:

> "When the same thing was offered again, I went back to the students and to the other science teacher who would have been involved, but the topics were still the same. I guess that was a drawback because they weren't particularly interested in the other topics" [*From interview with Lyn Moss, Hawker College*]

The second reason she cited was a lack of interactivity during the first visit:

> "What they [the students] didn't like about the first visit was that it was just talking. There was nothing visual, there were no demonstrations, there was nothing that they could actually get involved in" [*From interview with Lyn Moss, Hawker College*]

When asked more generally about what factors might deter them from participating in outreach, two of the non-participant teachers voiced concerns regarding the level of organisation required of them.

The four participant teachers had difficulty nominating anything that might deter them. When probed a little further some things mentioned were: if it were to become consistently boring; if it became purely a careers talk without a science component; and if it was not geared to the students' level and turned them off what they were currently learning.

Difficulties

When asked what difficulties they faced in their involvement in the UnIChe outreach program, all four participant teachers said they encountered little to no difficulty whatsoever. Two of them mentioned that some effort was required in organising the visit, but did not consider it an onerous task:

> "No problems at all. Good with the school, good with you guys" [*From interview with Frank Schermann, Vincentia HS*]

> "It was dead easy" [*From interview with Paul Werner, Leeton HS*]

Each of the non-participant teachers emphasised difficulties associated with organisation, when asked about the general challenges of engaging in outreach.

All teachers raised the issue of time as being a potential challenge to taking part in outreach in three ways: in relation to fitting things into a complex school timetable; in terms of accommodating the many different things that get offered to schools; and also in relation to the limited time available for teachers to get through the curriculum:

> "Difficulties are our timetable constraints... schools do get involved in a lot of, not just science things but across the board, all things that are available" [*From interview with Lyn Moss, Hawker College*]

> "We've got course outcomes to complete and only a limited time to do it so we tend to stick to getting the course finished in a reasonable time frame with time for revision at the end" [*From interview with Paul Werner, Leeton HS*]

Characteristics

Participant teachers were asked for their opinions regarding the style and content of the UniChe outreach program. Two teachers made comments regarding the level the presentations were pitched at, and the language used. Both regarded the presentation as being pitched too high and the language too difficult:

> "I think that the people that presented have to try and bring it down a notch so the students at high school level can understand it" [*From interview with Frank Schermann, Vincentia HS*]

However, speaking about his students from the rural town of Cootamundra, Brian Huntington provided an interesting perspective:

> "Bearing in mind that these kids are very insular and very isolated in their thinking, and when material like that is presented to a lot of them who hadn't thought about it and hadn't even realised that those things were there, it's sort of above them. But by the same token it makes them stretch and reach towards it, and I think we need that as well" [*From interview with Brian Huntington, Cootamundra HS*]

On the topic of presentation style, there were a number of positive comments. Two teachers commended the use of multimedia technology for its professional look and as a good example for students to follow, since the students themselves are expected to make presentations using Microsoft PowerPoint. One teacher applauded the interactive nature of the program:

> "I thought the style was good because it was like a multimedia format where they did a little bit of talking and then they showed the slide show. There was also a section where they brought out some chemicals, mixed them together, showed the kids various things, so I thought it was all very good" [*From interview with Frank Schermann, Vincentia HS*]

Other teachers however, felt that the presentation was dry and offered little in the way of interactivity. As described in a previous section, the one teacher who had participated in the pilot program in 2001, but chose not to participate in 2002, cited a lack of interactivity among her reasons for choosing not to participate a second time.

The topics of the presentations offered in the UnIChe program also attracted comment. Two teachers were attracted to the program at least partly because of the presentation topics, either because the teacher thought they were generally interesting or because at least one topic was linked to what the students were learning in class:

> "... and we had already talked about that in chemistry, and it showed the kids that there's another way of looking at it..." [*From interview with Frank Schermann, Vincentia HS*]

Impacts

To gauge teachers' perceptions of the impact of outreach on the school, students and the university, a series of questions were asked of all teachers.

Both participant and non-participant teachers were asked what they consider the benefits of outreach to be, to schools and students. In response, two teachers said that outreach builds awareness among students of university and life after school in general; four said it has the effect of humanising universities and scientists and provides role

models for students; and two listed outreach as giving students the opportunity to experience something beyond their normal everyday classroom environment.

> "I think it offers some direction... people who are coming in from outside who have studied those subjects at school and then gone on to do something in that area, it shows them that those pathways are available" [*From interview with Paul Werner, Leeton HS*]

> "...they see a human side to scientists, instead of what is often typecast on TV or movies..." [*From interview with Bill Needham, Mulwaree HS*]

> "The main [benefit] would be accessing something beyond their everyday environment... any opportunity they have to get thinking beyond schools is a big plus..." [*From interview with Barry Christianson, Ulladulla HS*]

Apart from numerous comments on the positive impacts of outreach, two teachers thought that in reality, only limited impact on students could be expected from single visits, citing previous outreach experiences with other programs.

Participant teachers were also asked about what they thought their students had gained from engaging the in the UnIChe outreach program. Three thought it had offered their students an alternative view to their own and shown real-life applications of chemistry outside the classroom.

> "An insight into chemistry, in particular, in action in other areas, rather than in the classroom itself" [*From interview with Paul Werner, Leeton HS*]

> "...they could see another use for the things that they have been learning, and another way of looking at them" [*From interview with Frank Schermann, Vincentia HS*]

One teacher thought that the program had a profound effect on his students, making university a real consideration for students that had never thought about it before:

> "The big thing that it does is that it opens up the kids' minds to that there are other things out there. A lot of our kids are rural kids and so very focused on the town and the region. And now we have kids thinking about going to Uni... and they see science as a career option now, and that's something these kids had never thought about" [*From interview with Brian Huntington, Cootamundra HS*]

Several of the participant teachers also mentioned benefits that they themselves had received from participating in the UnIChe outreach program, such as being able to see a different way of influencing students in science and altering their own perceptions of universities and creating a closer link with them. One teacher considered the program as direct support to his goal of generating enthusiasm in science:

> "We really want to generate enthusiasm... in the kids... And when that support comes in from organisations outside of the school, it sort of enhances that process and makes our job easier" [*From interview with Brian Huntington, Cootamundra HS*]

All teachers were asked what they thought universities gain by conducting school outreach programs. Two teachers thought that it creates a point of contact with schools and portrays universities in a positive light from a school's perspective. One teacher thought that universities might gain students from the exercise, while one considered it unlikely that students would be swayed to go to a particular university by such a visit. Two non-participant teachers held more cynical views on the motivation of universities running outreach; one believes that universities run outreach because they are required to fulfil some community involvement, while the other considers it is often a blatant attempt to attract students:

> "I could be cynical and say that universities are doing it now because it's one of the requirements" [*From interview with Lyn Moss, Hawker College*]

> "Sometimes it comes across as an opportunity to trawl for potential students at the school, to go to the university. And it's... quite blatant in a way. They just seem to be trying to canvas potential students" [*From interview with Bill Needham, Mulwaree HS*]

Past outreach

Teachers were also asked about their participation in past outreach programs. One teacher couldn't recall involvement in any other outreach aside from the UnIChe school outreach program:

> "No, I don't think we have from memory. That was the one and only one that came through" [*From interview with Brian Huntington, Cootamundra HS*]

For one other teacher, the UnIChe school outreach program is the only outreach he had ever encountered, however his school had participated in the program twice; during the pilot and the following year.

The remaining five teachers had all been involved in several other university-based outreach programs, as well as some from other sources, such as museums. Activities that could be considered a form of outreach, such as university-hosted study days and competitions, were also mentioned.

To learn more about these varied experiences, more probing questions were posed. When asked where the programs had originated, teachers mentioned the ANU, University of NSW, University of Wollongong and Charles Sturt University. With the exception of the University of NSW, these universities could be considered the "local" university of the school visited. Other sources listed were Questacon and the Reptile Museum.

The topic of outreach was almost exclusively science based. The one careers teacher interviewed mentioned an art-based program as well as an engineering program the school had been involved in. She also mentioned the Wollongong University LINK program, referred to in the literature review in Chapter 2.

On the evaluation of these programs, the response was mixed. Both favourable and unfavourable comments were made regarding the nature of presenters and the perceived impact of the programs.

Two teachers made comments made regarding the age of the presenters in relation to their effectiveness in the role, suggesting that youth is important:

> "The person who came was young, so the students could relate very much to him" [*From interview with Lyn Moss, Hawker College*]

Another teacher thought that it is the mind-set of the presenter, rather than age, which makes the difference:

> "It depends on their attitude really... I think if the person is outgoing and makes it interesting and fun and pitched at the kids' level, they're the criteria" [*From interview with Bill Needham, Mulwaree HS*]

One teacher relayed his scepticism about programs setting minimum numbers for attendance:

> "People seem to want a certain number of people attending their presentation, and sometimes it's counterproductive. If you've got a hundred kids in a hall, I really think you can write off sixty percent within the first two minutes... so smaller is better" [*From interview with Bill Needham, Mulwaree HS*]

About students

Although no questions were specifically asked on the topic, teachers made several comments regarding the characteristics of their students in relation to outreach—in particular, how they respond to certain presentation styles and topics.

For example, two teachers believed their students would not gain much from a lecture-style presentation:

> "One of the problems with kids... they switch off too easily. And so in some ways, they don't really want the chemistry lecture" [*From interview with Anne Dynon, Bomaderry HS*]

> "A lecture would be a turn off, because I know the kids won't respond to it" [*From interview with Bill Needham, Mulwaree HS*]

Several teachers made reference to their students responding well to hands-on involvement in the classroom. Regarding a topic such as chemistry, which is

conceptually a difficult subject for many students, one teacher thought that outreach activities need to be simple:

> "...these kids are just getting a feel for chemistry, and I think they need to... be excited in a nice, easy way" [*From interview with Frank Schermann, Vincentia HS*]

One teacher pointed out that using topics which students can relate to, including those popularised on television, can be an effective way to get through to students:

> "The things we found particularly useful here is the applications of science to everyday life, like forensic science... incredibly popular here... in that way you can use the subliminal effects of say, CSI on Tuesday nights on Channel 9, or other forensic shows, and the kids actually relate to it better" [*From interview with Bill Needham, Mulwaree HS*]

Two teachers mentioned how easily a presenter can "lose" their student audience if they project the wrong attitude or simply give a poor presentation, and alluded to the detrimental effect this can have in the longer term:

> "... the students, it doesn't help their attitude. They can become blasé about it all. No, it doesn't help at all" [*From interview with Lyn Moss, Hawker College*]

Communication and relationships

Opinions on communication issues and the relationship between schools and universities were also sought from the teachers during the interviews.

An issue highlighted by one teacher was in relation to the challenge of communicating offers of outreach to other teachers within the school:

> "Internally it can be a bit difficult to make sure all the staff know what's going on" [*From interview with Anne Dynon, Bomaderry HS*]

Several teachers emphasised the need for presenters to communicate science at a level suitable for the audience, particularly, as pointed out by one teacher, given the reputation of science as being difficult:

> "... the other thing is, we're fighting with the, or combating the perception... the social perception, this subject is a difficult subject conceptually, the terminology is difficult... so when you have specialised terminology as you have in science, it becomes an issue" [*From interview with Bill Needham, Mulwaree HS*]

Four teachers made comments about the impact of school outreach in building relationships between schools and universities. One teacher considers outreach as a form of support from universities, which builds a feeling of goodwill towards them. One teacher believes that it establishes links between the school and university and makes universities cognisant of the conditions in schools. Similarly, another believes it gives universities an insight into how science is taught in schools, and how secondary students are being prepared for tertiary study.

Interviews with university staff

Two of the staff who had been part of delivering the UnIChe school outreach program, were interviewed as part of this study. The questions asked of them were listed in Chapter 3 on pages 43–44; they concerned their involvement in the UnIChe school outreach program and about their opinions of outreach more generally.

Staff involvement

Both staff were asked about what had influenced them to get involved in the UnIChe outreach program. One staff member, Dr Philip Reynolds, was already a participant in the larger UnIChe project at the ANU and saw an opportunity for the program to expand to include school outreach:

> "Melbourne and Newcastle Universities [partners in the UnIChe program] were already involved in school outreach, and it became clear that there was no outreach to speak of in science at ANU... so we thought it would be a good use of UnIChe money as it fell within the... scope of the original proposal to set up a school outreach program" [*From interview with Philip Reynolds, ANU*]

The second staff member, Dr Michael Collins, joined the program after being approached by Dr Reynolds. He agreed to contribute to the outreach program based on

his belief that bringing students into contact with scientists provides a valuable experience for those students.

> "Philip came to see me and explained what the program was about, what the idea was. And it seemed a sensible thing to me to be exposing... kids in the last years of high school to hear what practicing scientists have to say about their work" [*From interview with Michael Collins, ANU*]

Both believe that university staff, in particular scientists, should not only be involved in outreach, but that community engagement is part of their duty.

> "Outreach to the community is part of the university staff's responsibility, and it is so described in our job statements nowadays. When one writes reports for people, administrators, you talk about research, teaching, administration and outreach now... Outreach has crept in there as a category in which a university staff should be performing" [*From interview with Philip Reynolds, ANU*]

As initiator of the UnIChe school outreach program, Dr Reynolds explained that he was responsible for inviting other staff members to become involved in the program. When asked how staff responded to his requests, he said he encountered no difficulty in enlisting help among staff of the RSC for schools within the ACT, but that for the more distant country schools, there was some hesitation.

When asked of the difficulties faced in delivering the program, Dr Reynolds particularly laboured the point of the amount of communication with schools required to coordinate visits. This was a factor he had not initially appreciated, and it led to him to employ a coordinator to assist with the logistics of running the program.

> "It became clear that there was an awful lot of telephoning and organisation.... So we decided to employ some young persons who were A. cheaper and B. the school children would relate to better, which was done" [*From interview with Philip Reynolds, ANU*]

The issue of the time that must be sacrificed to visit more distant schools was also raised by both staff.

> "The only difficulty is the time required, since it generally requires travelling to far-flung places very often, so it's basically a day gone" [*From interview with Michael Collins, ANU*]

Both staff believed the program had been well received by the schools visited, although Dr Reynolds added a caveat:

> "It's clear that some schools, in the ACT for example, are snowed under with such enterprises from various sources, University of Canberra, all over. And so in some places it was clear we were doing a very good thing... but in other places it was clear [we were] basically not welcome" [*From interview with Philip Reynolds, ANU*]

Impacts

To gauge the perceptions of the university staff regarding the impacts of the UnIChe school outreach program, several questions were asked. In response to the question of whether they thought the program had been worthwhile from both the schools' and university's perspective, Dr Collins felt unsure as to what impact the visits may have had on the schools:

> "It's difficult to judge from audiences... I didn't have the opportunity to discuss at any great length with the teachers or the students whether they got anything out of it. You just have to go... by the body language... They weren't fidgeting or anything like that... they seemed to stick with me right the way through, so in that sort of manner I think they got something out of it, but it's difficult to judge" [*From interview with Michael Collins, ANU*]

Regarding his own experience, he didn't feel as though he had gained any particular benefit from his involvement, but had not expected to. He did think that perhaps he gained a very superficial insight into the school environment.

Dr Reynolds believes his commitment to starting and running the program directly demonstrates his belief the program was worthwhile. He was uncertain about the actual impact of the program on student numbers however, stating that he had tried an

analysis of the relative enrolments and retention rates, but could not, at that point in time, decipher any significant results.

The staff were then asked more generally, what they believe are the benefits outreach programs impart to schools. Dr Reynolds suggested outreach puts a human face to universities:

> "It provides students with not only information, which many of them are lacking, but also provides them with some indication that the institutions they are going to are full of people, rather than strange, foreign places" [*From interview with Philip Reynolds, ANU*]

He thought the content of the presentations to be particularly valuable for country students, whom he believes generally know very little about the university environment.

Using his own school experience as a guide, Dr Collins considers the exposure to practicing scientists, the greatest benefit to students from outreach programs.

> "Thinking back to when I was at school, I think we would have benefited from actually meeting some scientists... and just sort of listening to them talk about their work, and getting some idea of the different sorts of things that scientists do" [*From interview with Michael Collins, ANU*]

When asked of the general benefits universities engaged in outreach may receive, both staff believe that more and better students are hopefully attracted to study the particular subject, in this case chemistry.

> "The university gains hopefully, a better type of student; a more able student" [*From interview with Philip Reynolds, ANU*]

Dr Collins also holds that beyond directly attracting students, outreach is a way of gaining recognition for the university. For the ANU this means recognition not only as a national institution, but particularly in the surrounding region:

"...it's like BHP advertising that they make steel. I don't think it really has much influence on the people who buy steel; they probably already knew that they made steel. It's just recognition in the general community. So it's that factor I think, as much as... attracting students to chemistry. It just sort of reminds students around the region that the ANU exists" [*From interview with Michael Collins, ANU*]

Dr Reynolds also recognises that there are several different models of school outreach, and that the relative impact of these different styles may differ:

"There are a number of different models of school outreach within chemistry at the moment. ANU has one sort of model, Melbourne has another, Newcastle has yet another. Newcastle for example is the entire Science Faculty, and it's not concentrated on chemistry. Melbourne targets specific schools, rather than trying to cover every school, and targets those schools much more deeply, i.e. by encouraging classes to come in and do things. It'll be interesting over the next three to five years to see which is the most successful, and which is an appropriate model for school outreach in general. And there are other places in other states. University of South Australia has schemes going. It is the fashion of the moment, school outreach. One of the fashions of the moment, and people really haven't... a consistent model of how best to do it" [*From interview with Philip Reynolds, ANU*]

Coordinator's report

The logistics involved in organising the 2002 UnIChe school outreach program are detailed in the coordinator's report [Fountain, 2002]. The sequence of events that took place during the organisation of the program, as relevant to this research, is relayed in this section. Formal feedback from teachers recorded at the time of the program is described in the following section.

At the time of my appointment as outreach coordinator for the 2002 UnIChe school outreach program, several aspects of the program had already been established during the pilot phase in 2001. These included the four staff from the RSC who had been involved in delivering outreach to schools, as well as their presentations, which

remained unchanged from the previous year. Some teacher contacts were also handed down from the previous coordinator, although many of these proved to be out of date just one year later.

Upon assuming the role of coordinator, I began contacting teachers to arrange visits to schools. The method of approach involved communication with teachers in three stages: initial phone contact, sending out an information pack, and individual communication [Fountain, 2002: 6-7].

The initial contact stage was by far the most arduous; an exhaustive amount of communication was required to systematically inform teachers about the program. During the UnIChe outreach program, I contacted teachers over the phone to garner their interest in the program. It was incredibly difficult to speak to the appropriate teacher and often I had to leave a message (sometimes more than once) which most often, was never returned by the teacher. In only 24 out of 46 schools was I able to speak to an appropriate teacher.

The best times to call were before class began, lunchtime (provided the teacher was not on playground duty), free periods and after class. Timing varies between schools, so individual information about timetables had to be obtained from each school.

During the initial phone conversation, I began with a personal introduction and followed with a succinct description of the outreach program. In every case when I was able to speak with an appropriate teacher, they expressed interest in participating in the program.

Following interest in the program from teachers after our initial conversations, I sent them a pack containing more detailed information about the program including timetabling options. The information was sent either by post, email or fax, depending upon the teacher's preference. For the schools at which I was unable to speak directly to a teacher, I simply sent the supporting information without having spoken to anyone at the school. Figure 4.1 shows the teachers' preferred method of receiving the information.

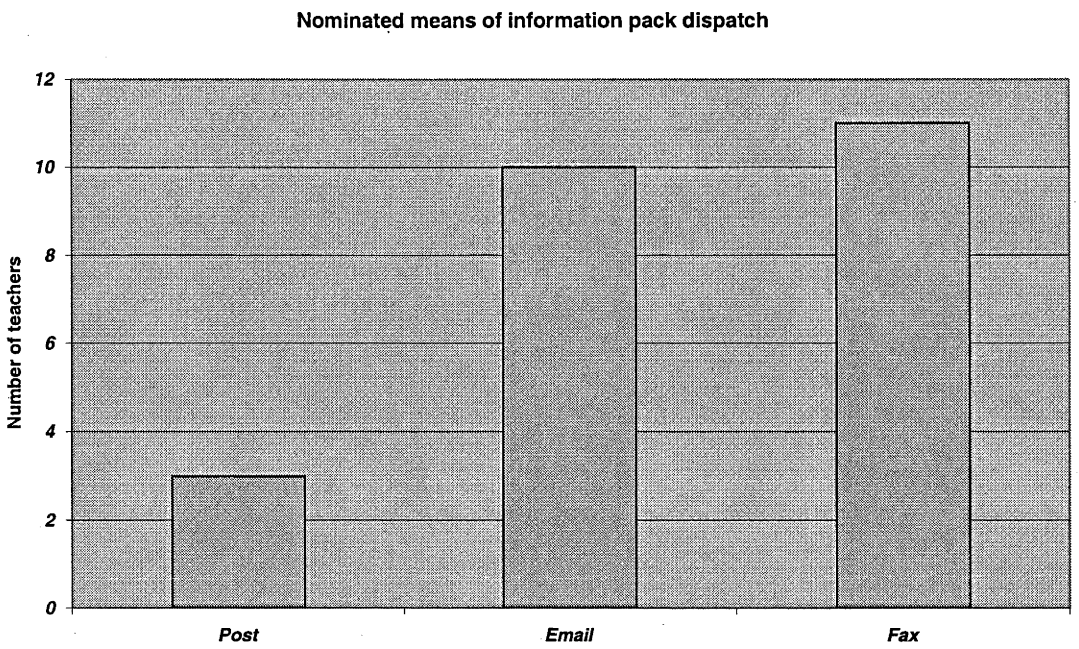

Figure 4.1 Distribution of teachers' preferences for receiving the information pack. For schools where no teacher could be directly contacted, information packs were sent via the post, but are not included in this chart. [Modified from Fountain, 2002: 7]

Timetable options sent to schools in the ACT and Queanbeyan areas were broad, encompassing dates between March and July 2002. In an attempt to group visits to schools in more remote areas, these schools were given more limited days to choose from. This tactic was used to minimise the necessity for multiple journeys to the more distant regions.

Once teachers returned the completed forms, I either telephoned or emailed the teachers to finalise and confirm the details of our outreach visit. Although all 24 teachers spoken to expressed interest during the initial telephone conversation, nearly half of them never returned the forms, nor pursued further communication with me.

In the end we made fifteen visits to thirteen schools, reaching a total of nearly 450 students from Year 10 to Year 12. Formal feedback from some of the teachers at these schools is detailed in the following section.

Formal feedback

During the running of the UniChe outreach program in 2002, survey forms were handed to teachers during the school visits. Some teachers filled in forms on the spot, while others faxed them back at a later time. Seven forms were returned in total, from the thirteen schools visited.

The forms consisted of nine questions targeting five areas: impressions of the introductory talk, impressions of the chemistry talk, overall acceptance of the material by the students, the level of interactivity and the usefulness of the information folder provided. Teachers were asked to rate each on a scale from excellent through to appalling. Figure 4.2 shows the average ratings for the five areas of feedback.

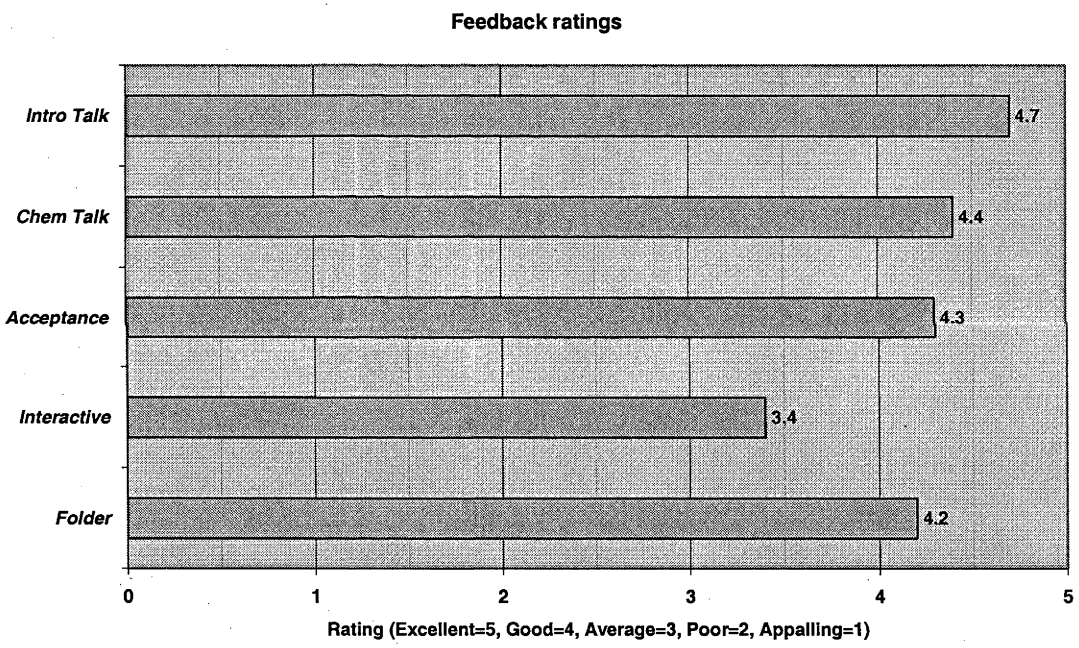

Figure 4.2 Average ratings for the five areas of feedback [Figure 5 from Fountain, 2002: 12]

While not too much emphasis is placed here on the results of the survey, they generally suggest that the visits were well accepted overall, although interactivity was perceived as the weakest component of the areas surveyed.

All seven teachers said they would like to repeat the program in the future. All but two teachers thought the material was pitched at the correct level for the students. The

other two teachers felt the material was too difficult for the junior students (below Year 11) who attended the session. Teachers were also asked to nominate whether they would like to arrange a visit to the RSC for their students. All but one teacher expressed interest in bringing their students to the ANU, although one highlighted that cost for transport and the impact on other lessons consequently missed make it difficult for schools to commit to such a visit. The one teacher not interested in an excursion to the ANU was from a remote rural school.

The form also invited teachers to make open-ended comments and suggestions for the program. Several comments echo sentiments shared by teachers interviewed during this study. Two teachers suggested the program be linked at least in part, with the chemistry syllabus. One teacher proposed the presentations should have a more practical and interactive component, and should make mention of financial remuneration during the careers section. One teacher was impressed by having two female presenters and considered them as excellent role models in an all-girls school. The inclusion of a young, female, non-scientist as part of the program was also commended by another teacher.

Summary

This chapter examined the responses of teachers and university staff interviewed during this study, the sequence of organisational events undertaken in the coordinator's report, and formal feedback from teachers during the UnIChe school outreach program.

The questions asked of teachers uncovered, for both the UnIChe school outreach program and for outreach more generally, the attractions and dissuasions; the difficulties involved; the characteristics and impacts, and; their past experiences of outreach. Teachers also shared their opinions about the characteristics of their students and issues relating to communication and relationships with universities. The questions asked of university staff explored the motivation for their involvement in the UnIChe school outreach program; the difficulties and challenges faced, and; investigated their opinions of outreach more generally.

Insight into the logistical events involved to organise the school visits was gained through examination of the coordinator's report, and formal feedback from teachers uncovered a variety of attitudes to the UnIChe school outreach program.

The research findings described in this chapter are presented in relation to the research questions in the final chapter.

Chapter 5: Conclusions

Introduction

The research findings presented in the previous chapter aimed to answer the following research questions:

Why was the participation rate in the UnIChe school outreach program so low?

(a) Why did schools, or more specifically teachers, choose to participate or not in the program?

(b) Why did university staff get involved in the program?

(c) What communication issues arose between the university and the schools, and in communicating science to the school students?

The chapter examined the responses of teachers and university staff interviewed during this study, the sequence of organisational events undertaken in the coordinator's report, and formal feedback from teachers during the UnIChe school outreach program.

Considering the topics identified in the literature review together with analysis of the data in this study, a number of themes emerged. Within this final chapter, these themes are presented in relation to the research question; each sub-question is dealt with in turn, and is finally drawn together to answer the main research question and to address the theoretical proposition. A research summary and recommendations are also given.

A teacher's decision process

Why did teachers choose to participate in the program?

In answering this sub-question, the data analysis uncovered several influential factors, each of which is discussed below: exposure to past outreach; school-based issues; perceptions of the impacts of outreach; and perceptions of universities. In exploring each of these factors, the reasons why some teachers chose not to participate in the program also become apparent.

Past outreach: the great divide

As patterns and themes within the interview data emerged during the data analysis, one factor seemed to stand out from all others: the relative level of exposure teachers have to outreach.

All teachers interviewed, as well as those surveyed for feedback during the program, have been involved in some kind of science outreach activity from either a university or other source. For some, the UnIChe outreach program is just one of many outreach experiences; for others it is the only program the teacher, or even school, has ever engaged in.

The differing levels of contact with outreach is largely based on the relative number of outreach offers made, rather than on the decisions by some teachers to refuse more offers. A distinct divide exists between schools in metropolitan and larger regional areas and those in remote rural areas; whereas the city schools are inundated by invitations to participate in outreach, few offers are made to rural schools.

Opinions held by teachers about school outreach parallels the division of opportunity. At the most basic level, teachers with little access to outreach voiced more broad-scale comments that tended to be sentiments of appreciation and a desire to gain access to more outreach:

> "I really appreciate any approach that is made" [*From interview with Anne Dynon, Bomaderry HS*]
>
> "We'd love to access anything that's going around" [*From interview with Brian Huntington, Cootamundra HS*]
>
> "I am all in favour of university outreach; I just wish there was more of it" [*From interview with Frank Schermann, Vincentia HS*]

Views of teachers with greater exposure to outreach were more specific, focusing on particular aspects of outreach, such as the nature of the presenters, presentation style, and program logistics.

The same pattern of opinion was held specifically about the UnIChe outreach program. On the whole, teachers with little or no other access to outreach tended to make a more generous appraisal of the program, compared with the more critical assessment offered by those involved in a range of outreach programs.

But while rural schools are genuinely more appreciative of any approach made, it should not be interpreted to mean that they be considered easier to satisfy; rather that the relative inexperience of rural schools in engaging in outreach, by default means they have no benchmark to compare against, no way to distinguish what factors make one program outstanding compared with another.

When questioned more intently about the qualities of outreach that they would consider important for a program to have, the rural teachers identified many factors in common with their more "outreach savvy" city counterparts, confirming the interpretation that it is merely a lack of opportunity and a desire to experience more outreach that motivated such affirmative comments, not that they are satisfied by a program of lesser quality.

Teachers' prior experiences with outreach are a major influence on their opinions and attitudes towards outreach and inform their appraisal of new offers of outreach. Consequently, each new outreach encounter will continue to shape teachers' views on outreach.

In the schoolyard: school-based issues

While the original proposition for this study considers characteristics of the program, it does not account for factors within the school environment that may play some part in a teacher's decision to participate in outreach. This is not a complete lack of foresight, since this research aims to identify features of outreach program design that universities should adopt; however, consideration of the school environment is critical during the design process, as the data for this study indicates.

Difficulties

While the virtues of outreach are appreciated by most teachers, all state difficulties of varying degrees that exist within their own schools and the school system as a whole,

that make participating in outreach activities challenging. Some of these difficulties seem endemic to the school environment, while others seem to follow the pattern of relationship to outreach accessibility.

For a university to visit a school, a level of organisation is required from both sides. But where a university is likely to have a program coordinator or some other support structure to deliver the outreach, from the school's side it is the teacher that must bear the burden of coordinating the needs of such a visit. The tasks involved may be logistical—such as locating a classroom space; managerial—such as finding a suitable slot in the school timetable that fits in with teaching requirements; or even diplomatic—in the case of negotiating with teachers from other faculties if the time will impinge on the teaching of other lessons. It is a burden that some teachers interviewed—especially those from larger schools—are far from keen to take on. On the other hand, those with less access to outreach seem more willing to do whatever is needed to make the outreach happen:

> "When things are on offer, we make the necessary arrangements to access them, and we are quite happy to do that" [*From interview with Brian Huntington, Cootamundra HS*].

Issues of organisation are compounded in metropolitan and regional schools where student numbers are larger, and the secondary impacts on the school are considerable:

> "Our school is big, so if you want to pull just one year group out and get them involved... in the junior school, you've got eight, nine classes running at once, so it impacts on the rest of the school" [*From interview with Barry Christianson, Ulladulla HS*].

Another major concern is the huge pressure on teachers to get through the syllabus, while at the same time trying to accommodate increasing numbers of approaches from institutions, not only universities, and across different subjects within and outside of science. With so many other pressures on time, teachers face a difficult task to cover all of the material in the syllabus.

While outreach is generally considered by the administering university to be a service being offered to schools, this is not necessarily the view held by schools. With such

competing pressures on school time, accommodating outreach from universities simply applies further demands on teachers to adjust their lesson plans to complete the material in time. From the school's perspective, the balance of power is reversed; accepting outreach is seen as the school sacrificing time to the university:

> "We've got a syllabus that we're always pushing to get through and so many outside things that... it has to be really worthwhile before we can give time to the program" [*From interview with Lyn Moss, Hawker College*]

However, as discussed in the previous section, the pressure of time and the large number of approaches made to schools are not spread evenly. While for the metropolitan and larger regional schools it was a point heavily emphasised, it carried little weight with the smaller, rural schools.

What teachers want

With so many offers coming across their desks, teachers have to consider the relative merits of each program, and consider the potential benefits for students, as well as the impacts on the teachers and the rest of the school. Reference has already been made regarding the pressures teachers face in getting through the curriculum, so it is not surprising that teachers want outreach that has relevance to what they are teaching.

Offering outreach on a topic related to what students are learning could go a long way to change the perception of outreach from being another pressure on time, to a valued contribution to meeting syllabus requirements. This should not be construed as universities taking on responsibility for meeting the curriculum requirements of schools, but rather as a mutually beneficial situation; one in which the teachers and students benefit by being exposed to something relevant in a new way, and the university benefits by gaining a greater understanding of what is being taught in science classrooms. This in turn has a two-fold benefit, as the universities are more aware of the kinds of science that school students—prospective students of their own—have been exposed to, as well as going some way to break down the ivory tower perception of universities and establishing good relationships with schools.

Apart from being relevant, the outreach should also be interesting and stimulating *for the students*. These qualities seem obvious, and every program surely aims to achieve this—but whether or not they do is another thing.

Speaking about a Professor from another university that had visited Bomaderry High School, careers teacher Anne Dynon observed that, "he goes on too long about things that are interesting *to him*". In a similar observation, Bill Needham from Mulwaree High school says, speaking about outreach programs, "they are all interesting and they're all valuable, and all important in the *proponent's mind*, but we've got to look at the big picture too for the kids".

How kids think

The primary audience for any outreach program is school students. Consideration of how best to reach this target audience should be a foremost concern in designing programs of school outreach. Although the students themselves are not directly responsible for making the decision to engage in outreach, as suggested in the comment by Bill Needham above, it is with the best interests of the students in mind, that teachers judge offers of outreach.

Giving weight to this view, the language used by teachers in response to questions about what they would consider important for outreach, very often reflected the point of view of students:

> "...the seniors, they'd like to see a direct reflection as far as the school's outcomes are concerned" [*From interview with Barry Christianson, Ulladulla HS*].

This is a subtle point, but one which highlights that above all, it is the best interests of their students, which the teachers are most concerned about.

Given their intimate knowledge of their own students, teachers made several comments regarding the characteristics of their students in relation to outreach—in particular, how they respond to certain presentation styles and topics.

Universities need to recognise that catering for a secondary student audience presents different challenges than does a tertiary audience. Students in a university chemistry lecture have actively chosen to study the subject, whereas for most school students, there is little choice involved.

> "...the other thing you have to bear in mind is that you've got a really mixed audience. The fact that they're all doing chemistry or all doing science, doesn't mean that they really like science" [*From interview with Anne Dynon, Bomaderry HS*]

Such students are unlikely to be captivated by a presentation that could be described as a "lecture", and understandably, the expression did not sit well with the teachers interviewed. There was a strong indication that students respond far better to more hands-on or interactive presentation styles, particularly for conceptually difficult subjects like chemistry, and for students of lower ability.

Helping to break down the perception of science held by some students that it is difficult and irrelevant by using topics which students can relate to, including topics popularised on television, can be an effective way to get through to students. Within an outreach perspective, this requires universities to actively seek understanding of teenage student culture and an effort to incorporate these themes into outreach program design.

Within the school environment, there are several factors that influence the ability and desire for teachers to engage in outreach. Difficulties surrounding the level of organisation required, pressure to complete the syllabus, and timetable constraints, all diminish a teacher's inclination to engage in outreach. Programs that are most likely going to attract teachers, therefore, place limited onus on teachers to organise, and contribute to, rather than compete with, completing the syllabus. Consideration of how best to communicate with students should also be made during program design, including the content and style of delivery.

Impacts of outreach

Teachers' perceptions of the impacts of outreach figure largely in their decisions to engage in outreach activities. Not only are the positive outcomes of outreach considered, but also any negative impacts on their students and the wider school community. Given the pressures on time already discussed, teachers seek involvement in outreach that offers valuable outcomes to their students, for the time invested.

All teachers interviewed agreed that outreach can have positive outcomes for their students. An outreach visit to a school brings a new face into the classroom; someone who can offer students an alternative view to that of their teacher. The outreach presenter may bring with them experimental or hands-on activities different to those regularly experienced by the students. They can introduce new topics or applications, broadening students' experiences of science beyond the classroom.

Personal contact with someone from a university can also give students a view into life after school—an insight into the pathways that are available to them. Universities cease to be mysterious places and instead they are given a human face. Few students would have contact with working scientists, so outreach also humanises scientists.

Given the reputation of science as being conceptually difficult, several teachers believe that a good outreach program can go a long way to changing this perception among students. However, some believe the opposite can also occur; a bad experience can actually turn students off. Head science teacher at Mulwaree High School, Bill Needham, believes some outreach from universities comes across as simply an "opportunity to trawl for students" to attend *their university*, a phenomenon he believes is not only detrimental to the university, but to science as a whole.

> "I think it would be better for science if it didn't have that slant, because somewhere they might spark the interest and go to *a university* somewhere and do science... The kids will hang their hat on how the person projects themselves, and if they don't do it well, it can have a negative effect" [*From interview with Bill Needham, Mulwaree HS*].

Several teachers thought that in reality, only limited long-term impact on students could be expected from single visits. They mentioned programs they had been involved in which they thought were neither brilliant nor awful, but rather indifferent, having had no long-term effect on the students at all. In contrast, single visits thought of as being excellent are those that the teachers said they would continue to engage in. Hence begins a longer-term relationship between the university and the school, and a much greater chance of influencing the university and subject choices of students over a period of time.

The perceived impacts of outreach are an important consideration for teachers contemplating engaging in outreach. Teachers recognise there are some positive impacts of outreach on their students, but universities need to be wary of outreach coming across purely as a recruitment exercise. While the long-term impacts of a single visit will be limited, building relationships with schools will contribute to achieving more lasting impacts.

How schools perceive universities

Universities have gone a long way in recent years to divorce themselves from the ivory tower persona that has been long-associated with academe. This is likely due to the recognition by universities that they cannot exist in isolation from the communities in which they exist; an idea evident in the acknowledgment of community service as an important component in the strategic plans of many Australian universities as explored in Chapter 2.

As far as schools are concerned however, there is still work to be done. The literature review revealed that in the area of teacher training, there is a lack of credibility of universities arising from the perception that they are out of touch with schools. If universities approaching schools in outreach programs seem aloof to the needs of the classroom or fail to acknowledge expertise within the school, then this ivory tower perception may also affect the credibility of academics in the university-school outreach relationship. In the opinion of several teachers in this research, it would appear that this is sometimes the case.

> "...the one thing I think universities have to come to terms with is... you know how there was a perception that the universities were an ivory tower at one stage? Sometimes the people who come from universities still have that persona about them, and that really is totally inappropriate... I don't think he meant to do it, it was just he's probably been in the university a long time and that's the way he operated and his personal values were that way. And that's fine, but not in the context of the school" [*From interview with Bill Needham, Mulwaree HS*]

Not only does the projection of this attitude get teachers offside, Bill Needham also believes that it can actually turn off students as well:

> "The kids pick 'em up. I mean kids are really good at reading people, summing them up really quickly. They may not say anything, but they don't miss much, so you can lose them very quickly" [*From interview with Bill Needham, Mulwaree HS*]

Through contact with schools however, it is hoped that universities will gain a greater understanding of the everyday experiences of the classroom and so be better equipped to design outreach that is suited to classroom needs:

> "... the professors et cetera, are forced to look at what things are really like one step down, and so become more aware" [*From interview with Anne Dynon, Bomaderry HS*]

There is still a perception among schools of universities being perched on ivory towers, far removed from the everyday experiences of the classroom. Universities offering outreach cannot expect to gain credibility with either school teachers or students unless they are attentive to the needs of schools, and make a conscious effort to approach schools as equals.

Summary

Several factors which influenced teachers' decisions to engage in the UnIChe school outreach program have been identified: exposure to past outreach; school-based issues; perceptions of the impacts of outreach; and perceptions of universities.

Teachers' prior experiences with outreach are a major influence on their opinions and attitudes towards outreach and inform their appraisal of new offers of outreach. Consequently, each new outreach encounter will continue to shape teachers' views on outreach.

Within the school environment, there are several factors that influence the ability and desire for teachers to engage in outreach. Difficulties surrounding the level of organisation required, pressure to complete the syllabus, and timetable constraints, all diminish a teacher's inclination to engage in outreach. Programs that are most likely going to attract teachers, therefore, place limited onus on teachers to organise, and contribute to, rather than compete with, completing the syllabus. Consideration of how best to communicate with students should also be made during program design, including the content and style of delivery.

The perceived impacts of outreach are an important consideration for teachers contemplating engaging in outreach. Teachers recognise there are some positive impacts of outreach on their students, but universities need to be wary of outreach coming across purely as a recruitment exercise. While the long-term impacts of a single visit will be limited, building relationships with schools will contribute to achieving more lasting impacts.

There is still a perception among schools of universities being perched on ivory towers, far removed from the everyday experiences of the classroom. Universities cannot expect to gain credibility with either school teachers or students unless they are attentive to the needs of schools and make a conscious effort to approach schools as equals.

The university viewpoint

Why did university staff get involved in the program?

In answer to this sub-question, analysis of the data revealed several aspects of university staff involvement in the UnIChe school outreach program: their motivation for involvement, the difficulties of involvement, and the perceived benefits of outreach. Each of these areas is discussed below.

Motivation

The two staff interviewed during this study were each motivated differently to participate in the UnIChe school outreach program. Dr Reynolds first identified the potential to run a school outreach program as part of UnIChe, and later approached other staff within the RSC, of whom Dr Collins was one, asking them to offer their time to the outreach program.

Through his involvement in the program, Dr Reynolds' aim was to attract students to study chemistry at the ANU. He hoped the program would stimulate excitement for chemistry in school students and raise their awareness of future career paths in chemistry. An underlying motivation was the low percentage of eligible students within the ANU catchment area that actually begin a study of chemistry at the ANU, which, according to the UnIChe Project Review Submission, was just 25 % in 2002 [UnIChe, 2002: 28].

On the other hand, Dr Collins was not driven specifically to attract students to study chemistry at the ANU. Rather, he was enthused by his belief that by participating in outreach, he would provide a valuable experience for students. He reflected upon his own school experience, and considers that as a student he would have benefited from meeting working scientists. He did hope however, that this experience may in the long run inspire them to look into chemistry and possibly the ANU as an option when they come to decide what they want to do after finishing school.

From the university perspective therefore, outreach can serve a dual purpose: as a tool for recruitment, but also as a service to schools. Both staff believe community service forms an integral part of their role as scientists at the ANU, and it is in fact a formal

requirement of staff tenure that they engage with the community. Outreach is just one aspect of community engagement in which staff participate.

Difficulties

Staff involved in outreach face several difficulties. The first is the considerable amount of effort required to coordinate visits with schools. Upon realising just how much work would be involved, Dr Reynolds enlisted the services of a coordinator to run the UnIChe school outreach program.

A further difficulty is the time needed to actually visit schools. This was particularly limiting during the UnIChe school outreach program, as quite distant schools were targeted. While Dr Reynolds was directly employed by the UnIChe project and could therefore justify the time involved in making overnight stays in the more distant regions, he felt it was too great a burden to ask other RSC staff to make. Indeed, while he reported having little trouble gathering support for outreach at local Canberra schools, he encountered greater hesitation among staff to visit the more distant schools. Understandably, once outreach activities require staff to be taken away from their main responsibilities of teaching and research, they are less willing to take on this extra assignment.

Impacts

For a university, the perception of the impacts of outreach form part of the motivating factors for running outreach. Since the aim of the UnIChe school outreach program was to attract students to study chemistry at the ANU, logically a perceived outcome is that more and abler students will come to the ANU as a result of the program. Indeed, Dr Reynolds has tried to analyse enrolment data to see whether there has been any differential increase in enrolments among the schools visited during the pilot and 2002 programs, but did not obtain conclusive results. Nevertheless, Dr Reynolds strongly believes the UnIChe school outreach program was worthwhile, saying he would not have initiated the project if he didn't think it was inherently valuable.

In agreement with teachers, university staff also believe that outreach provides students with an insight into life after school, and humanises universities. The staff themselves also gain some appreciation of the school environment, and of the

challenges teachers face in teaching classroom chemistry. As discussed earlier, this can contribute to breaking down the perception held by schools of universities as ivory towers, and to establishing relationships between universities and schools.

Summary

University staff involved in the UnIChe school outreach program were influenced by several factors: their motivation for participation; the difficulties encountered; and the perceived impacts of outreach. From the university perspective, outreach can serve a dual purpose: as a tool for recruitment and also as a service to schools.

Difficulties for staff involved in outreach largely relate to the sacrifice of research and teaching time needed to prepare presentations and to visit more distant schools.

The potential impacts of outreach are that the university may gain more and abler students, as well as some insight into the way chemistry is taught in schools. This can inturn contribute to changing the perception held by schools of universities as ivory towers. The students gain information about the career paths available and a more human picture of universities.

More than just talking

What communication issues arose during the program?

There were several avenues of communication during the UnIChe school outreach program, and these tended to follow a sequential order. Firstly there was communication within the university, followed by communication with teachers, and lastly communication with school students. Each of these areas of communication, and the issues that arose within them, are discussed below.

Communication within the university

Dr Reynolds, as part of the wider UnIChe project at the ANU, observed in 2001 that the other two universities involved in UnIChe—Melbourne and Newcastle Universities— were conducting school outreach. He believed there was an opportunity for such activities to be included as part of UnIChe at the ANU, since he saw that

"there was no outreach to speak of in science at the ANU" [*From interview with Philip Reynolds, ANU*].

From interviews with teachers, and from the literature review, it seems there was some outreach activity going on in ANU science at that time, but that Dr Reynolds was unaware of it. If there were existing programs, they possibly were not widely publicised within the university.

Had he known of existing outreach programs in science at the ANU, Dr Reynolds may have chosen to coordinate the UnIChe school outreach program with these during the pilot phase. He certainly intends to do so as the program develops.

> "Yes, there will be some combination with physics... so there needs to be some coordination there, but now the Faculty of Science, or at least physics/chemistry will be together" [*From interview with Philip Reynolds, ANU*].

Coordinating outreach in this way ensures that programs complement each other, and also centralises the contact point with schools, minimising the amount of liaison required with teachers, which, as described in the following section, is considerable. It also means teachers need only liaise with one person, rather than a different person from each subject area, aiding communication between the university and schools.

Communication of outreach within the university is extremely important to ensure staff designing new programs are aware of what is already being offered by other disciplines. Only through awareness of existing programs, will a newly designed program be complementary. This factor is critical, given the number of programs competing for time within schools. Under such circumstances, a university can ill-afford to be competing against itself. A coordinated approach also provides a single contact point for schools which can aid in building relationships between schools and the university.

Communication with teachers

From the very beginning of the UnIChe school outreach program, it was apparent that a huge amount of communication with schools is required; first to raise awareness of

the program, and subsequently to coordinate visits. Dr Philip Reynolds, as initiator of the program, recognised this task would overwhelm his work program, and thus a coordinator was employed to run the pilot outreach program—a role I undertook during the subsequent 2002 program.

A database containing school details, some with teacher names, for the fifty or so high schools in the five districts surrounding the ACT had been prepared during the pilot phase of the UnIChe outreach program. This served as a basis for the 2002 program, although the database had to be amended as several teachers had left.

The flux of teachers in just one year illustrates the pitfall of maintaining only a single contact point within schools. If the only teacher who is acquainted with the outreach program leaves the school, there is potentially no remaining corporate knowledge of it, and the university is forced to initiate the relationship again from scratch. This occurred during the 2002 UnIChe school outreach program; some teachers who had participated in the pilot were no longer at the same school the following year, and other teachers spoken to at those schools were unaware of the program.

During the second phase of communication with teachers, information about the program, including timetabling options, was sent to those who had expressed interest in the program during the initial phone conversation. Fax was marginally preferred over email, with postage the least favoured option. While email is a convenient means for communicating with teachers, not all have access to email or use it if they do. Fax is still an important means for communicating with teachers. Limiting the distribution of information to a single means may alienate a large group of teachers, so universities should remain flexible in this regard. Very few teachers preferred to receive information through the post; therefore this method should only be used on a case by case basis when fax or email are unavailable.

Once the teachers returned the completed forms, communication via phone or email continued to finalise and confirm the details of the visit. Four chemistry talks were offered as part of the program, each presented by a different member of the RSC. The busy schedules of the research staff meant that often the speaker requested by a school was unavailable at their nominated time. Thus, in many instances the chemistry presentation had to be negotiated to fit with the schedules of the research staff

involved. Also, for the more distant schools, only Dr Reynolds was available as discussed earlier. Although this issue never led to an interested school not being visited, it often required tactful negotiation with teachers to persuade them to accept their third or last choice of presentation.

The amount of liaison required to just raise awareness of an outreach program is a huge communication challenge in itself. Once the difficult groundwork is done however, if contact with teachers is maintained on a more regular basis, there ought to be much less communication required during subsequent programs. Flexible options for communicating program information should be adopted by universities to allow for the different means preferred by teachers. Communication with teachers can require diplomatic negotiation to ensure the university can deliver outreach that satisfies the requests of schools, while remaining within the bounds of its own constraints.

Communication with students

Students were ultimately the target audience of the UnIChe outreach program, but it wasn't until actually visiting a school that communication with students could begin. This is perhaps the most crucial stage of communication, and the one in which poor communication can do the greatest damage.

During an outreach visit, there are two levels of communication with students; verbal and non-verbal. Verbal communication encompasses the language used to convey science content to students, and to inform them about university life, careers and other information. Non-verbal communication involves the way in which the presenter projects themselves and relates to the students.

Giving an example of a positive outreach experience, Hawker College teacher Lyn Moss mentioned a young man who visited the school as part of the "Adopt-a-Physicist" program from the ANU. She was largely impressed because he offered to speak about any topic that the students wanted, and so could address a topic directly in the syllabus. He was also an excellent communicator and the students could relate to him as he was young but very accomplished.

In contrast, she also mentioned hosting a guest speaker during National Science Week who "ummed and ah-ed" so many times that one of her students kept note of how many

times he did it. She was adamant that, "the people concerned need to be aware of themselves as science speakers, science communication people" [*From interview with Lyn Moss, Hawker College*].

As described in an earlier section, the persona projected by a presenter is quickly picked up by students. If a presenter seems aloof or out of touch with their audience, students will simply "switch off". Not only will this turn off the students, but it will also get the teacher offside—the person who ultimately makes the decision to participate in outreach. Mulwaree High School teacher Bill Needham described his exasperation at the presenter during a particularly bad outreach experience:

> "There was a fellow here from a university a few weeks ago and he may as well have been talking to himself because he was just so far over everyone's head. Even his manner was off-putting. And we were putting ourselves out, and I was thinking, 'Why the hell are we doing this?' We've got enough on our plate without putting up with this sort of stuff" [*From interview with Bill Needham, Mulwaree HS*]

Several teachers believe that outreach presenters should be young to enable them to relate well to the students; however Bill Needham suggests that the attitude of the presenter is more important than age.

> "It depends on their attitude really. I mean, I'm the wrong side of fifty, but I'd like to think that I can still hold a class, simply by the attitude or the perspective I frame the work with" [*From interview with Bill Needham, Mulwaree HS*]

He suggests that it would be better to train up a teacher within the school itself—someone "who's got the right personality to do it", rather than a university professor who is a qualified scientist, but not an effective communicator. Interestingly, this is the approach taken by Melbourne University, where UnIChe has supported a transition teaching fellow—a qualified teacher employed by the Chemistry Department—in a program of liaison with selected schools [UnIChe, 2002; 29].

During the critical stage of communication with students, both verbal and non-verbal communication needs to be just right. A presenter needs to be professional and

accomplished but should use language that is accessible to a student audience, especially avoiding scientific jargon. When relating to the students, age is not as important as having the right attitude.

A presenter can easily "lose" their student audience if they project the wrong attitude or simply give a poor presentation, as well as turn off the teacher who is ultimately responsible for making the decision to engage in outreach.

Summary

During the UnIChe school outreach program, several issues were encountered during communication within the university, between the university and teachers, and between the university and students.

Communication of outreach within the university is extremely important to ensure staff designing new programs are aware of what is already being offered by other disciplines. Only through awareness of existing programs will a newly designed program be complementary. This factor is critical, given the number of programs competing for time within schools. Under such circumstances, a university can ill-afford to be competing against itself. A coordinated approach also provides a single contact point for schools which can aid in building relationships between schools and the university.

The amount of liaison required to just raise awareness of an outreach program is a huge communication challenge in itself. Once the difficult groundwork is done however, if contact with teachers is maintained on a more regular basis, there ought to be much less communication required during subsequent programs. Flexible options for communicating program information should be adopted by universities to allow for the different means preferred by teachers. Communication with teachers can require diplomatic negotiation to ensure the university can deliver outreach that satisfies the requests of schools, while remaining within the bounds of its own constraints.

During the critical stage of communication with students, both verbal and non-verbal communication needs to be just right. A presenter needs to be professional and accomplished but should use language that is accessible to a student audience,

especially avoiding scientific jargon. When relating to the students, age isn't as important as holding the right attitude.

A presenter can "lose" their student audience if they project the wrong attitude or simply give a poor presentation, as well as turn off the teacher who is ultimately responsible for making the decision to engage in outreach.

Ultimately, communication is much more than just talking. The results of this research suggest that actually developing a relationship between the university and schools is the best way to ensure effective communication throughout all stages of an outreach program.

Answering the research question

Why was the participation rate in the UnICche school outreach program so low?

The original proposition behind this study is that outreach programs need to have *certain characteristics* to be "successful"— that is, to satisfy the needs of both partners: the university and the schools. Since the program is designed by the university, it *should* meet the university's own needs, so the proposition can be put another way: teachers will only engage in outreach if the program being offered has *certain characteristics* that meet their own criteria. The low number of schools that participated in the UnICche outreach program was interpreted as an indication that for the majority of teachers, the program did not have such characteristics.

This research has identified some of the program characteristics attractive to teachers. These characteristics include offering topics related to the syllabus and presenting them in a way that is stimulating and engaging for students. Minimising the effort required of the teacher in organising the program is also an attractive feature. A program with these characteristics is more likely to attract participation from teachers. However, while these are generally admirable features of outreach programs, the fact that the same program is not equally taken up by all teachers indicates that different teachers place greater emphasis on different features as there are other factors in play which affect schools and teachers differently. Some of these other influential factors have also been identified in this research. These include school-based issues,

experiences with past outreach, teachers' perceptions of the impact of outreach, and teachers' perceptions of universities.

These factors will vary from school to school and from teacher to teacher. Although universities cannot control these issues, as they can control the characteristics of a program, they can go some way to alleviating some of the obstacles involved. For example, school-based issues, such as time-tabling constraints, can be assuaged by offering more flexible options (although this undoubtedly brings its own challenges within the university itself). Universities can also work towards changing teachers' perceptions of universities and of the potential impacts of outreach, by involving schools more in the design phase of an outreach program and maintaining a dialogue with schools more generally.

Past outreach is a particularly important factor. Good and bad experiences may colour a teacher's perception of outreach: while good outreach can strengthen a good relationship based on positive outreach in the past, teachers have a long memory for bad outreach. If a school experiences what the teacher considers to be a bad episode of university outreach, the university may not get a second chance. A university may also suffer the legacy of a teacher's bad experiences with other programs. This leads to the observation, that while attracting those teachers who have not had any exposure to outreach poses many challenges for universities, a far greater task lies in attracting those who are long-jaded by their past experiences with it. This remains a challenge for universities, and is one that cannot be easily overcome, but which requires investment in developing partnerships with schools.

Outreach requires ongoing communication with schools. The huge effort involved in initiating contacts within schools should not be wasted; rather outreach should be considered to be a partnership between universities and schools in which communication is ongoing. In any partnership, two-way communication is also crucial.

Summary

As indicated in this research, a secondary science teacher's primary concern is getting through the subject syllabus in time and engaging in activities that provide the greatest benefit for their students. Therefore, teachers are more likely to choose to engage in

outreach that relates to the curriculum; places minimal onus on them to organise; and is delivered in a style that is engaging for their students. While these characteristics are generally desired by teachers, there are other factors that influence a teachers' decision to engage in outreach. These include the teachers' preconceptions about outreach formed through past experiences of outreach, including their perceptions of the impacts of outreach and their perceptions of universities. Issues within individual schools and across the school system also form barriers to participation, such as time-tabling constraints and curriculum pressures.

The low participation rate in the UnIChe school outreach program was therefore a result of a combination of these factors. Firstly, it did not have all of the characteristics that are most attractive to teachers. The subject matter was not related to material in the chemistry syllabus, and many teachers felt it was not delivered in an engaging style. On the positive side however, those teachers who participated in the program did not consider it any great task to organise and felt that participation was worthwhile for their students. The importance of past outreach cannot be overlooked. The preconception of outreach held by several teachers, of being time-consuming with little benefit for their students, meant that many were not willing to invest time in finding out whether this particular outreach program was worth participating in.

Schools during the UnIChe outreach program were given an opportunity to provide feedback on the program, but perhaps they could also have been given the opportunity to discuss their needs with the university in greater detail during the design phase. As discussed in relation to teacher training in the literature review in Chapter 2, mutual benefits can best be determined if both partners are involved in the design of the program.

Limitations

As described in the research methodology, the sample size for this study was small. Only seven teachers out of fifty approached to participate, chose to do so. Similarly only two university staff were available for interview, and the opinions of staff outside of the program were not sought.

However, the teachers who did respond to the invitation to participate in this case study are most likely those who hold strong opinions about outreach, and who also see

some value in outreach. By choosing to share their thoughts, they demonstrate their belief that those opinions will be valued and taken into consideration, and that this may lead to better forms of outreach from universities. Therefore, while the number of teachers who responded was small, those who did had valuable insights to share. Nevertheless, the research findings are limited to the opinions expressed by those interviewed.

Perhaps a later study could include the perspectives of a wider group of university staff, to allow more insight into the attitudes of universities to outreach activities, or include more teachers in this study.

Reflections and recommendations

This research has largely considered the outreach relationship from the viewpoint of schools. By completing a study of a single case of school outreach, it has sought to determine what factors influence teachers in choosing to engage in outreach from a university and to gain an understanding of the perceived benefits of such involvement. Starting with an outreach program that was not considered by those who ran it to have gained adequate involvement from schools, a research problem, and in turn a theoretical proposition was formed.

The formulation of the theoretical proposition deliberately assumed that in designing outreach, the university's interests are being met since it is they who choose what shape that outreach takes. Is this assumption true? From the university's perspective, what is the motivation for and aim of outreach? Is it a recognised part of the reward structure for staff? How is it viewed by staff not involved in outreach? These questions have been touched on through the analysis of interview data from the university staff involved in running the UnIChe outreach program, but they deserve further exploration. Certainly, these are questions that must be answered by a university contemplating outreach, if that outreach is to satisfy the university's own needs. Having a clear and realistic picture of what the university intends to get out of outreach, also sets up a means for evaluating the program.

The underlying motivation for running the UnIChe school outreach program was to attract students to study chemistry at the ANU. Dr Reynolds subsequently attempted to analyse enrolment data to see whether there has been any differential increase in

enrolments among the schools visited during the pilot and 2002 programs, but did not obtain conclusive results. Even if an increase did occur, attributing this to the UnIChe school visit alone is invalid, as it is impossible to ascertain what role the program may have played without actually interviewing the students to identify what factors influenced their decision to study chemistry at the ANU.

Research cited in the literature review indicates that materials distributed by careers teachers are the most used and most influential sources of information used by students when making decisions about tertiary study. Significant people in students' lives, such as family members and teachers, can also influence their decisions. This would indicate that the impact of a single outreach visit, on the university and subject choices of a student, is likely to be minimal.

It does suggest two things, however. If careers teachers are considered as trusted sources of information by students, it would appear that universities ought to supply information materials to them in order to reach students. It also implies that by building relationships with careers, as well as other teachers, universities would have a better chance of influencing students through them.

This is inline with the suggestion by Mulwaree High School teacher Bill Needham, that universities ought to consider training a teacher within the school to act on their behalf. It is also the model of outreach adopted by another UnIChe partner, the University of Melbourne, in which a qualified teacher was employed as a 'transition teaching fellow' to liaise with selected schools.

Only one careers teacher was interviewed as part of this study. Compared with the other six teachers interviewed, Anne Dynon, careers teacher at Bomaderry High School, mentioned involvement in more and diverse outreach activities. This is natural, since she is concerned with all subjects, not only science. She named contacts at several universities; one in particular is the schools liaison officer from the University of Wollongong with whom she said she is in frequent contact. Anne Dynon also declared that most students from the school end up choosing to attend Wollongong University. The fact alone that Wollongong University has a schools liaison officer, suggests the university makes a significant effort to develop relationships with schools in the region. Determining to what degree Bomaderry High School's more personal relationship with

people at the university contributes to student preferences is not within the scope of this study, but it would appear to have some influence. Anne Dynon spoke highly of her dealings with the university through the schools liaison officer—a sentiment that is likely passed on to students.

It seems universities contemplating outreach are faced with a conundrum—in light of low rates of science enrolments, and a suggestion from government that they play an active role in addressing this trend, aiming to use outreach as a recruitment tool seems an attractive plan. But in doing so, are universities wasting their time and money, or worse, putting students off science? Comments from teachers in this study suggest that poor outreach can do more than simply waste time; it can actually turn students off the subject.

This research indicates that a longer term approach is required. If science enrolment trends are to reverse and school outreach is to play a part, there are underlying issues that need to be addressed such as the quality of science classroom experiences and the accessibility of science. At the scale of individual universities, attracting science students will not happen through intermittent visits, but through establishing meaningful and mutually beneficial relationships with schools.

The following recommendations are made to universities contemplating science-based outreach:

When designing outreach programs, first determine what other programs exist within the university

A university may have a central outreach office, or individual faculties may be responsible for outreach within their discipline. Whichever may be the case, communication within the university itself should be the starting point of any outreach program. Only through awareness of existing programs will a newly designed program complement these. This factor is critical, given the number of activities competing for time within schools. Under such circumstances, a university can ill-afford to be competing against itself.

Consider the motives for running school outreach and determine a means for evaluating the program

Determining the reasons for wanting to run school outreach will allow the university to identify the expected outcomes and indicate a means for evaluating the program. As was the case for the UnIChe school outreach program, a lot of time and money is invested in running outreach programs. Determining the return on this investment requires a mechanism to measure or evaluate the program. During the UnIChe school outreach program, success was measured by the number of students reached (evidently less than hoped) and an attempt was made to determine a relationship to enrolment numbers. These may be valid means for evaluation, so long as the expectations for these are stated up front, and an adequate means for establishing these measures is adopted. Simply looking at enrolment numbers without determining the actual relationship to the outreach program, for example, is inadequate.

Determine the target audience and consult teachers within this group during the design phase

The best way to ensure that a program will meet the needs of both the university and the schools is to include both partners in the design phase. The target area must first be identified. At the ANU, students are very widely sourced, and hence a broad program of school visits was the chosen tactic. Given the large geographic area targeted during the UnIChe school outreach program, it would have been impractical to consult every science teacher from these schools. However, discussions with a small group of representative teachers could perhaps have informed the design process. Several of the outreach features most attractive to school teachers identified in this research, may have been identified during this design phase if this consultation had occurred.

Communicate the potential impacts of outreach to teachers

The perceived impacts of outreach are an important consideration for teachers contemplating engaging in outreach. When raising awareness of an outreach program, therefore, the potential benefits for students should be communicated to teachers. There is some suspicion among teachers that outreach is often solely a recruitment

exercise for universities, giving more weight to the importance of communicating the positive impacts of outreach on students.

Maintain ongoing communication with teachers

Outreach requires ongoing communication with schools. The huge effort involved in initiating contacts within schools should not be wasted; rather outreach should be considered to be a partnership between universities and schools in which communication is ongoing. In any partnership, two-way communication is also crucial; therefore teachers should be given the opportunity to provide feedback to the program, as well as being involved in the design phase as stated previously.

During the UnIChe school outreach program some teachers who had participated in the pilot were no longer at the same school the following year, and other teachers spoken to at those schools were unaware of the program. The flux of teachers in just one year illustrates the pitfall of maintaining only a single contact point within schools. If the only teacher who is acquainted with the outreach program leaves the school, there is potentially no remaining corporate knowledge of it, and the university is forced to initiate the relationship again from scratch. By maintaining closer communication with teachers, the university will be aware that their contact teacher at a particular school is moving on and may get an opportunity to establish a new contact before the teacher leaves.

Produce a diverse program and ensure adequate staff are available to commit to the program

While several outreach features attractive to teachers have been identified, the preferences of teachers are not entirely prescribed. Different teachers place greater value on different aspects of a program, therefore universities should develop programs that are reasonably diverse. For example, while a particular topic may be related to the syllabus, and the presentation is interactive and engaging and pitched at the right level, the actual topic may not fit in with what a teacher is teaching at the time. Offering several different topics, as was the case during the UnIChe school outreach program, allows to some degree for the different preferences of teachers. This then requires that there are adequate staff available to deliver the different topics. This was a problem during the UnIChe school outreach program, as only Dr Reynolds was available to

travel to the more distant schools, thereby giving these schools no choice in the presentation topic they received. Alternately, this can be alleviated if all staff involved in the program can present any of the topics on offer.

Consider how best to communicate with students

Universities planning to run school outreach, need to recognise that catering for a secondary student audience, presents different challenges than does a tertiary audience. More hands-on or interactive presentation styles should be favoured over a lecture-style presentation. This is of particular importance for science subjects that can be conceptually difficult for many students.

Regarding the presenter, the crucial factor is not who should present science outreach to schools, but what qualities they should have. Whether a school outreach program is presented by university staff, or presenters are employed specifically to run the program; whether they are young or old; they need to be able to communicate science effectively and be able to project the right attitude.

Further research

This research has brought to light several areas in relation to school outreach that deserve further investigation. Some of these are discussed briefly below.

Evaluation

If a university conducts a program of school outreach with the aim of achieving certain outcomes, then it needs to implement methods of evaluating the outcomes of the program. As discussed in the literature review in Chapter 2, program evaluation and measuring the impact of outreach, is no simple task. The means by which some American universities evaluate their outreach activities was described, but there is no definitive method described in the literature. Some interesting perspectives were offered by teachers during this study.

Bill Needham from Mulwaree High School questions the value of collecting feedback directly, as, although one visiting group was given a positive review by his students, to his knowledge, they failed to follow it up in any meaningful way:

> "The feedback they got was very positive, but significantly as far as I was concerned, none of the students followed it up after they left. And I think we went through about 200, 220 kids went to that, and none of them followed it up afterwards" [*From interview with Bill Needham, from Mulwaree HS*].

Alternatively, Hawker College teacher Lyn Moss perceives the invitation of feedback as a positive feature:

> "There was one thing that I found with the person who came to talk to us who was really good; he asked for feedback straight after. He emailed me that afternoon, and said 'I would really appreciate it if you could ask your students for feedback, both positive and negative to help me with doing things in the future'. And he was the only one who did that—and I thought that was interesting that that coincided with him also being such a good presenter that he was really interested in what could help him" [*From interview with Lyn Moss, Hawker College*].

While at first these comments seem opposing, analysing the meaning more closely, they are interpreted as the *method* of evaluation and the *intention* of evaluation. Bill Needham does not suggest that collecting feedback is meaningless; only that the method used was ineffective. In his response, a potentially more effective way to evaluate a program is suggested—by monitoring the *actions* of students following an outreach program. The comment of Lyn Moss is regarding the intention of collecting feedback—in this case, to assist the presenter to improve his presentation. This may seem like the obvious reason to collect feedback, but it certainly is not the only one; reasons may also include fulfilling requirements for reporting or gathering supporting comments to ensure the continuity of the program.

If outreach aims to influence the actions of students, by way of attracting them to study tertiary science, then it is those actions which should be captured. Dr Reynolds attempted to do this for the UnIChe outreach program by recording enrolment rates; however there is a great distance between a school visit, perhaps in Year 10 or even Year 12, and a student applying and enrolling at a university. As suggested in the comments by Bill Needham, it is the immediate actions which are critical; following a visit, do the

students follow it up in any way? Do they seek more information? These may be better indicators than simply ticking boxes on a form at the time.

University resources

Although the number of schools that participated in the UnIChe outreach program was lower than hoped, would the program have been able to deliver if all schools approached had accepted our invitation of outreach? Four staff from the RSC, plus the outreach coordinator (in a part-time role), were involved in delivering the outreach. In the case of schools outside of Canberra, Dr Reynolds was the only staff member who made himself available to make these visits owing to the greater time involved in overnight stays in the more distant regions. If more schools, particularly in distant areas, were to engage in the program, this would seriously increase the time demand on staff. If staff are then also asked to produce presentations that are not directly part of their own research, but are more closely linked to school curricula, the extra work involved could act as a further deterrent. If staff are not appropriately recognised for their contribution to such programs, it seems unlikely that a program will be sustainable under such circumstances.

What is the best way for a university to organise its resources for outreach? Does it require a full time coordinator? Should it be centralised? How will staff be recognised for their contributions? These are particularly important issues to resolve if a university is engaged in a broad program of outreach across several different disciplines.

Other models of outreach

The UnIChe school outreach program at the ANU used one model of outreach, but outreach may take different forms, as explored in the literature review in Chapter 2. Outreach may involve university staff visiting schools on a regular basis; schools visiting universities; professional development for science teachers; and any number of other different activities. Which is the best method in terms of attracting interest in studying science at university? Is there one single "best-practice" model of outreach, or does it depend upon the outreach objective, the schools and universities involved? As more universities engage in outreach, answering these questions will become increasingly important.

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Appendix A: Ethics approval

THE AUSTRALIAN NATIONAL UNIVERSITY

RESEARCH SERVICES OFFICE

Human Ethics Officer
Sylvia Deutsch

CANBERRA ACT 0200 AUSTRALIA
TELEPHONE: +61 2 6125 2900
FACSIMILE: +61 2 6125 4807
EMAIL: Sylvia.Deutsch@anu.edu.au

17 April 2003

Mrs Leharne Fountain
Postgraduate
Centre for the Public Awareness of Science
Faculty of Science

Dear Mrs Fountain,

Protocol 2003/37
Practical considerations for conducting a university-based school outreach program: a case study.

On behalf of the Human Research Ethics Committee I am pleased to advise that the above protocol has been approved as per the attached *Outcome of Consideration of Protocol*. Please note that as a formality this approval is subject to formal ratification by the Committee at its next meeting on 2 May 2003.

For your information:

1. Under the NHMRC/AVCC *National Statement on Ethical Conduct in Research Involving Humans* we are required to follow up research that we have approved. Once a year (or sooner for short projects) we shall request a brief report on any ethical issues which may have arisen during your research and whether it proceeded according to the plan outlined in the above protocol.
2. Please notify the Committee of any changes to your protocol in the course of your research, and when you complete or cease working on this project.
3. The validity of this current approval is five years' maximum from the date shown on the attached *Outcome of Consideration of Protocol* form. For longer projects you are required to seek renewed approval from the Committee.

Yours sincerely,

Sylvia Deutsch

Secretary, Human Research Ethics Committee

Appendix B: Ethics consent form

The following two-page form was sent to all interviewees, all of whom agreed to be quoted and identified in this sub-thesis, without restrictions.

CONSENT TO USE OF INTERVIEW MATERIAL
COPY TO BE RETURNED TO LEHARNE FOUNTAIN

I consent to be interviewed by Leharne Fountain from the Centre for the Public Awareness of Science, the Australian National University (ANU) as part of a project to write a case study for a sub-thesis, on the 2002 ANU Research School of Chemistry school outreach program. The likely length of this interview will be one hour or less and may be conducted in person or over the telephone. I understand that participation in the project is voluntary and that I may withdraw at any time. I understand that the interview will be taped for research purposes. I understand that I will be given an opportunity to comment on the interpretation of material from the interview in the final draft of Ms. Fountain's sub-thesis.

I also agree to (please answer yes or no):

Being quoted in the sub-thesis ----------

Being identified in the sub-thesis ----------

Any other restrictions ----------

Please note: all interview material will be stored in a locked filing cabinet in my home for the duration of the study.

Name (please print): ----------

Signed: ---------- Date: ----------

I, Leharne Fountain from the Centre for the Public Awareness of Science at the Australian National University agree to abide by the above conditions, so far as the law allows.

Signed: ---------- Date ----------

Contact details:
Leharne Fountain
CPAS, Faculty of Science
The Australian National University
ACT 0200, Australia
Tel: 02 6262 8889 or 6272 5738
E-mail: leharne@optusnet.com.au

If you have any ethical concerns about this project, please contact:
The Human Research Ethics Committee
C/- Sylvia Deutsch
Human Ethics Officer, Research Services Office
The Australian National University, ACT 0200
Tel 02 6125 2900, Fax 02 6125 4807
E-mail: Human.Ethics.Officer@anu.edu.au

CONSENT TO USE OF INTERVIEW MATERIAL
COPY FOR INTERVIEWEE TO KEEP

I consent to be interviewed by Leharne Fountain from the Centre for the Public Awareness of Science, the Australian National University (ANU) as part of a project to write a case study for a sub-thesis, on the 2002 ANU Research School of Chemistry school outreach program. The likely length of this interview will be one hour or less and may be conducted in person or over the telephone. I understand that participation in the project is voluntary and that I may withdraw at any time. I understand that the interview will be taped for research purposes. I understand that I will be given an opportunity to comment on the interpretation of material from the interview in the final draft of Ms. Fountain's sub-thesis.

I also agree to (please answer yes or no):

Being quoted in the sub-thesis ———————————————————————

Being identified in the sub-thesis ———————————————————————

Any other restrictions ———————————————————————

———————————————————————

———————————————————————

Please note: all interview material will be stored in a locked filing cabinet in my home for the duration of the study.

Name (please print): ———————————————————————

Signed: ———————————————— Date: ————————————————

I, Leharne Fountain from the Centre for the Public Awareness of Science at the Australian National University agree to abide by the above conditions, so far as the law allows.

Signed: ———————————————— Date ————————————————

Contact details:
Leharne Fountain
CPAS, Faculty of Science
The Australian National University
ACT 0200, Australia
Tel: 02 6262 8889 or 6272 5738
E-mail: leharne@optusnet.com.au

If you have any ethical concerns about this project, please contact:
The Human Research Ethics Committee
C/- Sylvia Deutsch
Human Ethics Officer, Research Services Office
The Australian National University, ACT 0200
Tel 02 6125 2900, Fax 02 6125 4807
E-mail: Human.Ethics.Officer@anu.edu.au

Appendix C: Transcript

Interview with Bill Needham, Mulwaree High School

Date: Wednesday 2 July 2003 Start: 2.00pm End: 2.19pm

Int: I am going to ask you a series of questions, basically open questions, and they are all based on your opinions and your experience of things. Now because you didn't participate in the program, I will ask one or two questions about that and then we'll move onto more general questions about school outreach in general. But because you didn't participate in the program, first of all, do you recall seeing anything, or do you know anything about it at all, or do you remember me phoning you, or receiving any sort of information about the program?		
Bill: To be honest, no, but that could be a failing of my memory, rather than a failing of people actually doing it. On average we get, I think I counted up something like between 70 and 200 such correspondences from all over Australia, and it just gets overwhelming.	Large number of approaches Massive contrast to rural schools like Cootamundra	[PAST]
Int: Yes, I guess this is what this research is about. The aim of my research is to get these programs so that they deliver what is needed to you. So if you had remembered about it, my next		

question would have been, what if anything deterred you from participating in the program.		
Bill: Well, automatically I have to look at the impact it has on the teachers and look at the impacts or the positives for the students. They would be the two determinants. If those impacts are worthwhile, if there's no great degree of extra onus put on the teachers then we might take it a step further.	Impact on both students and teachers considered No extra onus on teachers	[IMP] [SCHOOL]
Int: Specifically talking about that program then, you don't recall anything about it?		
Bill: If I haven't done anything about it then it's come to my desk and I've screened it at that level.	He can't offer specific information as he can't even remember that single approach	
Int: Now just to tell you a little about the program anyway, maybe you could give me an indication of what you think you might do with that. Now the program was run from the Research School of Chemistry at the ANU. It was targeted at mainly senior chemistry students, and the reason for that is because of the way the schools are in the ACT, being colleges separate from high school. But in NSW we did propose that year 10 might attend as well. The format took the style of being two presentations, in total the visit took an hour, and those two presentations, the first was an introductory, very low key just talking about		

careers in chemistry or where it can take you, that sort of thing. And the other one was a, I don't like to use the word lecture, but it was a talk by a research staff member, about an aspect of research that was going on at the ANU, and there was a number on offer. As I said, that took about an hour. The way I went about interest schools in the program was by initially phoning teachers up to gauge their interest, and if they were interested I then sent them information. Now as far as I can recall, and from my records, I did speak to you and did end up sending something to you, but from what I've said you could probably tell me...		
Bill: I could probably tell you that I've screened it at my desk level and chose not to go on with it.		
Int: That's fine. And that would be for the reasons that you reported originally.		
Bill: The reason being there are so many impacts on our teaching time now, that I really have to screen them from the point of view of the activities that people coming to the school would have to be positive for the curriculum.	Impacts on teaching time. Needs to have direct impact on learning outcomes for school	[IMP] [SCHOOL]
Int: Alright, what we'll do now is move on to questions about general school outreach.		
Bill: The other thing I need to say too is there is a detectable change in attitude in students and kids these days, and we would have probably a small	Speaking for his students. Most not interested in this	[STUD]

percentage of very good students who would be interested in that sort of a visit, but the majority would not be.	sort of visit	
Int: That's really important to know. And I guess when you get so many, you really have to try and get the most out of it for the most students.		
Bill: And the other thing is we're fighting with the, or combating the perception, I guess the social perception, this subject is a difficult subject conceptually, the terminology is difficult. Many students we have, not a lot but enough to take a note of, have literacy problems, so when you have specialised terminology as you have in science, it becomes an issue. Like schools all over Australia, we have a real battle to keep them interested in the subject.	Difficulty of science as a subject ⇨outreach could address this if done the right way ⇨expressing a need to make science accessible	[COMM]
Int: Now have you participated in any other school outreach programs, from other universities?		
Bill: No.	What does he consider as outreach?	
Int: You haven't at all. So when you say you receive a lot and you screen them.		
Bill: Well we receive a lot of invites to do a whole range of things. Outreach programs being one aspect of it. Others might be competitions, visits, like Questacon coming out to the school, visits by a reptile farm to come to the school. And you've got to weigh up just how important it is.		

Int: Okay, well I would group our visits, with outreach, and some of those things, I would term them outreach. So have you participated in those things?		
Bill: Yes, Questacon we have.		
Int: Okay, and was that a positive experience, would you do that sort of thing again?		
Bill: Well, the people who came, who were young not unattractive people male and female, they regarded it as a positive experience. The feedback they got from the students was very positive. But, significantly as far as I was concerned, none of the students followed it up after they [Questacon] left. And I think we went through about 200, 220 kids went to that, and none of them followed it up afterwards.	Impact of a single visit. How realistic a measure are the feedback results obtained?	[IMP] [STUD] [PAST]
Int: My next question would be, what benefit do you think these sorts of programs really have then for the students?		
Bill: I think there are two potential benefits. One is that they see a human side to scientists, instead of what is often typecast on TV or movies. The second is, if the science that is presented is interesting and is presented in a relevant way to these kids, you can turn them around in terms of their perceptions of the subject. Most, or almost all, the teachers at this school are middle-aged or older, so the persona they project is if you like a generation gap in itself.	Has to not only be interesting but also relevant to them, relevant to their lives	[IMP]

Int: Now, just to turn it around, what do you think universities get out of these sorts of programs?		
Bill: Well sometimes it comes across as an opportunity to trawl for potential students at the school, to go to the university. And it's almost not even, it's quite blatant in a way. They just seem to be trying to canvas potential students.	Negative image of universities. Even viewed offensively.	[UNI]
Int: Would you say then that, when universities visit, their message is about, not specifically about the science, but the science at *their* university then?		
Bill: Yes.		
Int: And would it, to you would it be more, would you feel more comfortable with it if it didn't have that slant?		
Bill: I think it would be better of for science if it didn't have that slant. Because somewhere they might spark the interest and go to *a* university somewhere and do science. I mean the kids will hang their hat on how the person projects themselves. And if they don't do it well it can have a negative effect.	Impact of a bad presentation is wider than just that university, but can impact science as a discipline	[IMP] [OUT]
Int: So what sort of attributes in a program, if they were to approach you, what sort of things would you look for that would make you decide, yes I'm going to participate in this program?		
Bill: The direct relevance to what I have to teach, I'm talking about seniors or year 10's. It's got to be interesting. The outreach program I'd turn into an	Importance of staff at the school ⇨ once the outreach is	

"inreach" program where we come to you. If you can't bring the gear to us, there might be the perspective where we can come down there and set up, and they can actually do hands-on such as a Science Week sort of experience. The things we found particularly valuable here, is the applications of science to everyday life, like forensic science, incredibly popular here. And it's simply brought about by the interest of staff who teach it, and having some good gear with which to teach it. And in that way you can use the subliminal effects of say, CSI on Tuesday nights on Channel 9, or other forensic shows and the kids actually relate to it better. So things like that. Other ones would be, forensic archaeology is a good one, or archaeology in general, dating excavations, anything that sparks an interest like that. And telecommunications is another one. We found a big interest for the kids of lower ability we've structured the science course to target things in their everyday life so when we talk about lasers, we talk about CD players and so we've targeted from that point of view and we've found that a way to unlock their interest, or redevelop their interest.	over it is the teacher who will take it further	[SCHOOL] [STUD] [STUD]
Int: On the other side of that, are there other things that would really deter you or turn you off participating in something?		
Bill: It depends on how much work I've got to do at this end, is a big one. The nature of the program, I mean you used the word "lecture" in inverted	Minimise effort for teacher.	[SCHOOL]

commas—that would be a turn off, because I know the kids won't respond to it. The nature of the person who delivered it would be a big thing.	Students won't respond to lecture. Nature of presenter	[STUD] [SCHOOL]
Int: Well just on that, when I mentioned what our program was, I gave the introductory part, and I'm not a school aged person, but I'm fairly young, but the person who did the second part of the presentation, not always but can be an older research scientist.		
Bill: Well it depends on their attitude really. I mean I'm the wrong side of fifty, but I'd like to think that I can still hold a class, simply by the attitude or the perspective I frame the work with.	Attitude of presenter rather than age is important	[SCHOOL]
Int: So you wouldn't want to generalise completely then?		
Bill: No, I think if the person's outgoing and makes it interesting and fun and pitched at the kids' level, they're the criteria.	Quote	
Int: Now you have touched on this a little bit, but what sort of difficulties from your point of view exist in participating in these sorts of programs?		
Bill: Well it's the number of things that come across the school's desk; this is not just science, but the school's desk. For example this year's year 11 this week is basically out of the school on various things. So that impacts for all subjects, there is a week's work that they don't have their lessons on. So it's got to be juggled, it's at the stage now where the executive has got to vet things	Competing across all subjects, not just science.	[SCHOOL]

now, and say "yay or nay" to various proposals to try and put the lid on some of this. Because they're all interesting and they're all valuable, and all important in the proponent's mind, but we've got to look at the big picture too for the kids. So that's a really big one. The amount of organisation I've got to do. There is a general inertia with kids these days towards doing anything. We don't run the excursions we used to run because kids are disinclined to even bother bringing in their note and money. In fact I had three kids not go on an excursion last week, fifteen dollars it cost them, they haven't even asked for their money back. So there is an inertia there. And it's not just this school; it's all over the place. I've heard teachers say the same thing. They're just disinclined to get out of their own road in a sense.	How do we fit into the whole? More holistic approach? Attitude of students – apathy?	[STUD]
Int: So on that point then, the idea of visiting schools at least and having it confined to one single lesson...		
Bill: It's far more attractive, but it's also the challenge for the people doing the project, because they've got to get through this layer and reach these kids.		
Int: Anything that can be a problem in participating in these programs?		
Bill: The only other thing is logistical things, like having rooms, re-rooming. People seem to want a certain number of people attending their		[SCHOOL]

presentation, and sometimes it's counter-productive. If you've got a hundred kids in a hall, I really think you can write off sixty percent within the first two minutes in terms of kids listening to you. So smaller is better.	Better to aim for smaller audience, more intensive?	
Int: Do you find that people or groups that approach you want larger numbers?		
Bill: Yes, they almost always want that.		
Int: And your opinion is that, you're not even really reaching all of those people.		
Bill: Well it's got to be good if you're going to reach a large number.		
Int: Well you mentioned earlier the Questacon, and you had at least 150, and they were possibly entertained, but didn't really...		
Bill: Oh, absolutely, it was drama and it was PowerPoint, and they had all these props and were young and good-looking.		
Int: Was that the Smart Moves program?		
Bill: What's that? Is that where you try and get kids involved in science courses?		
Int: Yes.		
Bill: Yeah, I think that was it.		
Int: There are a lot around.		

Bill: Yeah, and we get the reptile place coming and they've got twelve snakes and lizards, and they're all individually really nice, but if they want 120 kids, holding one snake up in front of 120 kids, it's not really. Well a snake will catch more kids' attention than most things, but you won't get them all anyway.		
Int: Well that covers the general things I wanted to ask you, so is there anything else you would like to add to that whole concept of school outreach?		
Bill: Well, just thinking as you asked the questions, the one thing I think that universities have got to come to terms with is, now I hesitate to use this term because it's really outdated in many ways, but you know how there was a perception that the universities were an ivory tower at one stage? Sometimes the people who come from universities still have that persona about them, and that really is totally inappropriate. In fact I think in many ways, you might be better off to take a member of staff out of a school and train them up to what you wanted, to get them to get it for you. The careers advisor or whoever, but someone who's got the right personality to do it. Rather than the other way. I mean there was a fellow here from a university a few weeks ago, and he might as well have been talking to himself because he was just so far over everyone's head. And even his manner was off-putting. And we were putting ourselves out, and I	Comment about who should be conducting outreach, the type of person.	[UNI]

was thinking, why the hell are we doing this, we've got enough on our plate without putting up with this sort of stuff.		
Int: So it's really coming at that level as an equal, not trying to portray a lofty height.		
Bill: But I don't think he even meant to do it, it was just he's probably been in the university a long time, and that's the way he operated and his personal values were that way, and that's fine but not in the context of the school.		
Int: And the kids, do you think they detect that?		
Bill: Oh, the kids pick 'em up. I mean kids are really good at reading people, summing them up really quickly. They may not say anything, but they don't miss much. So you can lose them very quickly.	Can't fool kids!	[STUD]
Int: Well thanks very much for all that. What will happen is, once I've reviewed all the interview material and any interpretation or things that are associated with this interview I'll give you an opportunity to look at and make sure you're happy with it. So you'll hear from me in the not to near future.		
Bill: Good luck with it.		

Appendix D: Sample Data

The following tables are a sample of the coded data. All data were entered into an Excel spreadsheet. Using the AutoFilter function, values could be selected and viewed based on code or other properties, creating subsets of the full dataset. Information entered for each data value includes the code and dimension, interviewee name, interviewee school, and identification of whether they were a participant or non-participant in the UnIChe program. Only the code, dimension and values are shown here.

Code	Dimension	Value
SCHOOL	DIFF	Cost element makes it hard to get participation rate we would have liked
SCHOOL	DIFF	Time factor of organising is a big detriment
SCHOOL	DIFF	Large school, hard to get things up and running
SCHOOL	DIFF	The way the school is structured produces timetable constraints
SCHOOL	DIFF	Organising anything at a school level is difficult
SCHOOL	DIFF	Usual difficulties of organising kids, times, places
SCHOOL	DIFF	Coordination factor, time-tabling problem
SCHOOL	DIFF	So many impacts on teaching time now
SCHOOL	DIFF	Number of approaches that school gets, not only science, but even within science
SCHOOL	DIFF	Logistical things like rooms
SCHOOL	DIFF	No problems, dead easy
SCHOOL	DIFF	Time is a factor, have outcomes to achieve and limited time to do it in
SCHOOL	DIFF	Constraint of time, got to get through the syllabus
SCHOOL	DIFF	Timetable constraints

Table B.1 Difficulties faced by schools in engaging in outreach

Code	Dimension	Value
IMPACT	STUD	Something beyond every day environment
IMPACT	STUD	Get kids out of the school
IMPACT	STUD	Thinking beyond schools
IMPACT	STUD	Contact with younger staff
IMPACT	STUD	Different face
IMPACT	UNI	General promotion of science
IMPACT	UNI	Uni initiating a point of contact with the school
IMPACT	STUD	See what the university has to offer
IMPACT	SCHOOL	Impacts the rest of the school especially for juniors
IMPACT	SCHOOL	Missing class isn't so much a problem... but teachers have to teach a course
IMPACT	STUD	Good transition
IMPACT	SCHOOL	Connects us with the next level
IMPACT	UNI	Don't think you necessarily gain more students
IMPACT	UNI	Humanises uni's so they cease to be such ivory towers, they become more accessible
IMPACT	STUD	It was more hands on than our usual experience of textbook learning
IMPACT	STUD	Opens up the kids' minds to see there's other things out there
IMPACT	STUD	They see science as a career option now, something they had never thought about
IMPACT	STUD	They got some general knowledge
IMPACT	STUD	Different perspectives on science from what they get here
IMPACT	STUD	New skills and also new ideas
IMPACT	STUD	Difficult material not necessarily a problem as it can make them stretch and reach towards it
IMPACT	SCHOOL	We can see other ways of influencing kinds in science
IMPACT	STUD	Showed the kids there is life after high school
IMPACT	STUD	Outreach shows kids that university life is there
IMPACT	UNI	They could get some good students
IMPACT	STUD	None of the students followed it up after they left even though they gave positive feedback at the time
IMPACT	STUD	See a human side to scientists

IMPACT	STUD	If interesting and presented in a relevant way, can turn their perceptions of the subject around
IMPACT	STUD	An insight into chemistry outside the classroom
IMPACT	STUD	Hard to gauge what students thought but many favourable comments
IMPACT	STUD	A number of them enjoyed it and got something out of it
IMPACT	STUD	Getting expertise
IMPACT	STUD	Able to take an experience of the subject out of the classroom
IMPACT	STUD	Offers some direction
IMPACT	STUD	Shows them the pathways that are available
IMPACT	STUD	Impact of the single visit was limited

Table B.2. The perceived impact of school outreach on students, schools and universities. The dimension code allows the impact on each separate group to be discriminated.